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Publisher : University of Groningen, Groningen, The Netherlands

Printed by : Ipskamp Drukkers B.V., Enschede, The Netherlands

Layout : Legatron Electronic Publishing, Rotterdam

ISBN : 978-90-367-5658-7 (printed version)

978-90-367-5743-0 (electronic version)

RIJKSUNIVERSITEIT GRONINGEN

Organizing Intra-Organizational Networks for Innovation

Proefschrift

ter verkrijging van het doctoraat in de
Economie en Bedrijfskunde
aan de Rijksuniversiteit Groningen
op gezag van de
Rector Magnificus, dr. E. Sterken,
in het openbaar te verdedigen op
donderdag 13 september 2012
om 14.30 uur

door

Hendrik Leendert Aalbers
geboren op 19 november 1980
te Zwolle

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Chapter 1

An Introduction to the Organization of Intra-Organizational Networks for Innovation

1.1 The value of innovation

In an age of disruptive innovation and unstable markets original ideas are currency and successful innovation is considered gold by many growth aspiring companies. Innovation is the capability of organizations to renew themselves and forms the epitome of competitive advantage. Yet, structuring innovation is more often seen as a 'contradictio in terminis' than as a viable strategic objective for corporate management. A prime reason for this discrepancy is the fact that in an era of technological advancement, generating new ideas remains a core competence entrenched in human cooperation. As a result the process of structuring for innovation is considered as complicated to manage. This is of relevance as such a perception might result in leaving innovation to chance, neglecting valuable innovative capital that might differentiate an organization from its competitors (Whelan *et al.* 2011).

Even if an idea could develop in isolation, human cooperation is still of essence to secure further enhancement into a successful innovation in terms of sponsorship, improvement and actual realization to make sure market benefits can be reaped (Obstfeld 2005; Ibarra and Hunter 2007; Ibarra 1993). The way in which this intra-organizational network of combined individual activity is organized determines in the end which organizations triumph over others in the market place. Still, for reasons varying from demanding data collection to the rather current development of proper methodology, intra-organizational networks are only beginning to be understood by organizational scholars. Yet, approaching an organization's innovative capital from a network point-of-view might be particularly helpful. The past has shown that the

degree to which organizational members are integrated into interpersonal networks affects the extent of overall organizational innovation (Albrecht and Ropp 1984). Furthermore such an approach allows us to focus on the relationships among people in organizations, rather than only the attributes of the individuals or the organization in isolation (Kilduff and Brass 2010). As effectively laid out in economic terms by Schumpeter (1934) and Barney (1986), the combination and exploitation of existing resources in new ways offers firms the potential to generate 'abnormal' rents as they manage to profit from internal information asymmetries (Galunic and Rodan 1998). These economic principles that uphold corporate entrepreneurship and innovation match well with the 'interactionist' approach of network analysis. As Granovetter (1973) and Burt (1992) argue, there are advantages to connecting to those who are not themselves connected. Connecting to diverse clusters provides novel information and different perspectives that can lead to creativity and innovation, whereas information that circulates within a cluster soon becomes redundant (Brass 2011).

1.2 Research question

To explore the relation between both formal and informal human collaboration within organizations and the management of innovation, this dissertation takes a network based view to intra-organizational cooperation and elaborates on the reasons as to why these networks might be seen as viable pathways to structure for innovation. This dissertation focuses on the network behavior of individuals as they position themselves in the wider organizational innovation arena. Much of the prior research on innovation has emphasized the role of the innovation community as an entity of its own. We on the other hand particularly articulate the behavior and network antecedents displayed at the individual level in relation to innovative activity. Following Albrecht and Ropp (1984) and Rodan (2010) we define innovation as the development of ideas for the advancement of new products and services and the improvement of existing products and services. Hence, the intra-organizational innovation networks studied in this dissertation are based on who talks about innovation with whom within the organization (Rodan 2010; Albrecht and Ropp 1984). We will refer to this type of interaction as innovative knowledge transfer (Zellmer-Bruhn 2003).

Identifying and transferring innovative knowledge within an organization helps firms to circumvent redundancies in which several internal parties start from the ground up solving the same problems (Nonaka and Takeuchi 1995). These activities also enhance an organization's capacity to render substantial rents from internally generated knowledge capital (Szulanski 1996; Zellmer-Bruhn 2003). The relevance of this network perspective is based on the early work of Kanter (1982) and Albrecht and Ropp (1984). They found that the highest rates of innovation originate from those organizational cultures that encourage collaboration, allow different forms of information to flow freely and feature coalitions of supporters and collaborators who work together on new ideas (Albrecht and Ropp 1984, p.80).

Drawing from cross-panel as well as longitudinal data this study addresses a number of intra-organizational network factors that can be related to a corporate climate that facilitates innovative knowledge transfer. Secondly it shows how managerial action can influence these factors to enhance intra-organizational innovative capacity. As such, this dissertation pivots around the following research question:

– *What characteristics determine involvement with intra-organizational innovative knowledge transfer, and how does managerial intervention affect these characteristics?*

1.3 Network theory as a theoretical framework

The term 'network' is used in a number of different ways in economic and organizational literature. Some use it metaphorically, indicating that a number of actors hold some kind of relations giving rise to particular kind of effects. Others have used the term 'network' to point to structures that are in-between market and hierarchy. These are hybrid forms which are not easily conceptualized by existing organizational theory or by mainstream economics (Powell 1990; Ouchi 1980). Finally, there is an increasing number of scholars stretching and crossing the disciplinary fields of sociology, psychology, biology, mathematics, economics, management, and even physics, who devote their attention primarily to the networks themselves, their workings, their nature.

This dissertation looks at the consequences of intra-organizational network variables, both at the network level (such as overall network cohesion and multiplexity) as well as at the individual level (such as having many ties or being hierarchically connected) on a firm's ability to foster innovation. In response to recent appeals for more longitudinal insight in the mechanisms that affect network characteristics we also study the evolution of the intra-organizational network as it progresses in time. As such, this dissertation is nested in what is formally defined as network theory, examining the mechanisms and processes that interact with network structures to yield particular outcomes for individuals and groups (Borgatti and Halgin 2011). A distinct aspect of network theory is its twofold focus on both the individual actors and the social relationships connecting them (Wasserman and Galaskiewicz 1994). In this dissertation we follow the widely acknowledged definition of Mitchell (1969) of a social network, referred to as: "*a specific set of linkages among a defined set of persons with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behavior of the persons involved.*" (Mitchell 1969, p.2). In this study we apply this definition to an intra-organizational environment.

The main benefits of social networks are derived from their capacity to generate, disperse, screen and enhance information (Campbell *et al.* 1986; Coleman 1990; Granovetter 1973). Burt (1997) elaborates on this benefit by stating that a network provides an actor with access to valuable information well beyond what the actor could process on its own. The network surroundings of an actor essentially act as additional processing capacity (Kijkuit and Van den Ende 2010). But with information technology increasingly catering to information gathering, it is especially the screening and enhancement of information which is the added value of today's social networks. In the light of intra-organizational innovation these abilities allow for the context specific interpretation and enrichment that eventually is believed to differentiate the corporate trailblazers from the laggards (Huber 1984; Kijkuit and Van den Ende 2010; Whelan *et al.* 2011).

1.4 The different building blocks of network analysis

The key contributions of this dissertation pivot around the organization of intra-organizational networks for innovation. Before moving on to these key contributions let us first briefly review some of the – what we call – key building

blocks that constitute network driven research. Without these building blocks network driven research is hard to execute.

Nodes and ties

As is commonly acknowledged, a network can be defined as a set of linkages among a defined set of persons that interact in a specific way. To interpret the characteristics of these linkages in more detail, a number of building blocks are commonly used to analyze network structure.

Nodes and the relations (ties) between these nodes form the key components of a network. Nodes are usually the individual actors within the networks, where ties are the relationships between these actors (Wasserman and Faust 1994). The more nodes interact in a network, the larger the network size. Within a network the intensity of interaction between the different nodes may vary. In case of close interaction between two nodes one speaks of a strong tie, whereas ad-hoc interaction is referred to as a weak tie (Granovetter 1973). The measurement of tie strength varies depending on the kind of network under investigation and the choice of the scholar studying the network. Diversity of ties is commonly measured by means of the number of 'bridging ties' and frequently linked to innovative capacity (Burt 1992; Hansen 1999; Perry-Smith 2006). In an intra-organizational context bridging ties are often perceived as ties that span across unit-boundaries, facilitating the combination of resources that otherwise would not be likely to be matched together.

Multiplexity

Organizations are complex systems in which different networks may be discerned (Borgatti and Halgin 2011). People have a tendency to combine different possible aspects of a relation into a single tie with a concrete other (McPherson *et al.* 2001). When studying networks in an intra-organizational setting it therefore is important to realize that a person operating in one network can simultaneously be nested in other networks of a different nature. This point of view is referred to as Granovetter's (1985, 1992) concept of social 'embeddedness'. Embeddedness is a multidimensional construct relating to the importance of social networks for action. The recognition that different networks might exist concurrently within an organization and hence different layers of interaction at the individual level simultaneously might be in place, allows for detailed information at the individual

level of interaction (Lincoln and Miller 1979; Robins and Pattison 2006). When these different possible dimensions of interaction combine into a single tie between two people this is known in the literature as 'multiplexity' (Ibarra 1993, 1995; Coleman 1988; Smith-Doerr and Powell 2005). Multiplexity has been shown in different contexts to produce beneficial results to the individual and to his social environment (Ibarra 1995; Burt 1984; Coleman 1988; Smith-Doerr *et al.* 2004; Minor 1983; Rogers and Kincaid 1981; Roberts and O'Reilly 1979). Studies in different settings have found that ties that combine multiple dimensions of a relation between two concrete individuals can have a substantial and qualitatively different effect in comparison to the effects of their constituting elements (Burt 1984; Smith-Doerr *et al.* 2004). Multiplexity has also been linked to innovative performance (Albrecht and Ropp 1984 ; Albrecht and Hall 1991; Cross *et al.* 2001). When individuals are connected in a number of different ways, more or even better information tends to be exchanged (Sias and Cahill 1998). This benefit is related to one's improved position in this network. Because of the extra knowledge a person can determine and interpret better how someone will behave in one context if her behavior and attitude is known from a different context. In other words: a relation of one kind keeps in check the negative side-effects of a relation of a different kind (Marsden 1981; Albrecht and Ropp 1984). Driven by recent reviews of network theory (Borgatti and Halgin 2011) we therefore identify multiplexity as another prime building block that requires further research in the pursuit to increase the understanding of intra-organizational innovation networks.

Network position: centrality and brokering roles

When discussing the building blocks that comprise a network structure, a notion that cannot be ignored is the way in which individuals are positioned and act within a certain network structure – their individual network position. These individual positions are of essence to understand the influence of network structure on the degree of knowledge-transfer and hence the innovative capacity of the firm. This point of view is well illustrated by Burt's structural hole perspective (2004), which

observes the role of individuals who connect two or more otherwise unconnected parts of a network. Such 'structural holes', as Burt calls them, will be able to exert control over the information flow within a network like a linking pin (Burt 2004). Burt (2004) showed that people thus placed may be in a better position to develop new ideas themselves. This linking pin principle is referred to as brokerage in the social network analysis literature and identified here as a prime network mechanism.

Kahn *et al.* (1964) were among the first to underscore the importance of such 'boundary positions' within an organization, and referred to them as the maintenance of in-depth contacts of an employee with employees from other organizational units, or even outside of the company. The number of contacts outside one's own organizational unit determines to a large extent the degree to which an individual has the potential to contribute to the innovative capacity of the organization (Perry-Smith and Shalley 2003). Taking this perspective one step further, one could say that similarities in individuals' behavior suggest the presence of a network role (Garton *et al.* 1997). Several authors have categorized[1] network roles by referring to an individuals' membership of a social group. Merton (1968) distinguished between the 'local' and the 'cosmopolitan'. Where the local is mainly oriented towards his direct social environment leading to social integration, the cosmopolitan is more interested in the world outside his own community, stimulating social differentiation (Merton 1968; Taube 2003). In an organizational setting, one of the most widely accepted network roles is the (technology) gatekeeper, as defined by Allen (1977). In this role diverse communication patterns are collapsed together into one single profile. The importance of access to knowledge which is not available in one's own unit make externally oriented roles particularly important in the earlier phases of the innovation process. However, it would be incorrect to conclude that the internally oriented individuals are unimportant for organizational networks. Knowledge needs to be absorbed, developed and possibly transformed before it can be applied within one's organizational unit or transferred to another unit or division. Before knowledge can be absorbed properly, an appropriate network structure has to be in place to guarantee access to this knowledge (Hargadon 2002). In this dissertation we study

[1] One of the more fine-grained conceptualizations of such brokerage roles was developed by Gould and Fernandez (1989), which encompassed five theoretically distinct triadic options of the network broker that also included the direction of communication.

the interplay between the internal and external, as well as the horizontal and vertical orientation of actors within intra-organizational networks as we explore the role of network position in relation to the innovative capacity of the firm.

Next to brokerage, centrality-based measures are another acknowledged indicator of an actor's embeddedness in an organizational network. Several centrality measures have been developed describing the flow of and access to information that an individual has compared to others within a network. These measures are focusing on the speed of knowledge-transfer (closeness-centrality) or the number of direct contacts (degree centrality) available to the individual (cf. Freeman 1979; Brass and Burkhardt 1992). Being on the shortest path when knowledge flows is also essential when discussing innovative knowledge transfer (Brass and Burkhardt 1992). Innovative knowledge transfer is closely linked to the adoption and diffusion of innovations. Therefore, the network characteristics that might be beneficial to this type of exchange are of particular interest (Burt 1992). Being in the loop of things and being the first to find out are beneficial to the creation of truly new insights (Burt 2004; Sparrowe *et al.* 2001), can generate positive publicity for innovation and allows for the hampering or blocking-off of competing activity (Bonner *et al.* 2002; Kijkuit and Van den Ende 2007). Hence, centrally positioned individuals have been found to be more innovative than less centrally positioned individuals (Ibarra 1993). However, not every actor is equally well placed to fulfill this knowledge broker role as different network positions offer different opportunities for individuals to access a variety of knowledge sources (Burt 1992; Tsai 2001). The degree to which actors fulfill such positions within networks is frequently investigated using betweenness centrality as a measure (Wasserman and Faust 1994). Betweenness centrality indicates an individual's degree of control of the flow of communication within a network (Freeman 1979).

The key assumption of the various forms of centrality is that the power of individual actors is not an individual trait, but arises from their relations with others (Freeman 1979). Actors that face fewer constraints and have more opportunities than others are in favorable structural positions (Hanneman and Riddle 2005). In this dissertation we emphasize the importance of including network affiliation and direction of communication and take particular interest in cross boundary communication – both within as across the boundaries of the firm. In doing so we will apply both centrality based as well as a brokerage based network lenses.

Motivation

The last, but quite commonly neglected, building block in the quest to understand intra-organizational innovation networks is closely linked to the question as to how individual differences predispose actors to position themselves in a network of relations. Organizations could influence individual actions to help accomplish favorable outcomes to the organization as a whole (Foss 2007). Such orchestration starts with an understanding of both what motivates the individual to transfer knowledge, as well as, structurally, with whom individuals may be expected to exchange knowledge. The first point is based on earlier research on creativity that found that the degree to which individuals get involved in innovative activity varies depending on individual motivational characteristics (Amabile 1997; Teigland and Wasko 2009; Mudambi *et al.* 2007). The latter is determined by an individual's position in the knowledge transfer network of an organization. And although the relationship between network structure and individual motivation has been receiving moderate attention over the last decade (Kadushin 2002; Kalish and Robins 2006), the number of different issues addressed in this new literature remains rather limited. Data at the level of individuals in a firm is particularly rare. As recently observed by Kijkuit and Van den Ende (2010) the traits that add to the networking skills of employees in an innovative context have remained largely unexplored. Social network researchers seldom discuss the effects of individual psychological differences on network structure (Mehra *et al.* 2001) and particularly not in the context of innovative knowledge transfer. Studies have only started to touch upon the effect of individual psychological differences on network structures (Klein *et al.* 2004). Taking into account the individual psychological antecedents of individual network actors is therefore the final building block we add to this dissertation.

1.5 Organizing intra-organizational networks for innovation

Despite wide acceptance that intra-organizational networks are important for organizational and individual outcomes, we know surprisingly little about how intra-organizational relationships evolve over time or how a firm's interaction patterns can be influenced by managerial action (Balkundi and Kilduff 2005). Knowledge on this matter is particularly scarce when centering on intra-organizational innovation (Tortoriello 2007; Bartunek *et al.* 2011). Further research therefore can produce

understanding of what constitutes success or failure of the intra-organizational innovation network by analyzing several of its structural characteristics (Smith-Doerr *et al.* 2004; Kijkuit and Van den Ende 2010).

After establishing a common notion on what defines a network and after identifying the prime building blocks of this dissertation earlier in this chapter, let us now turn to the research structure laid out in this thesis to answer the overall research question. This dissertation is organized around a number of distinct structural network antecedents that are of relevance to organize for innovation, as well as around two distinct types of managerial intervention, each of which will be discussed in further detail. These elements are addressed in six separate chapters, categorized in three main parts. Each of these parts that together form this dissertation is introduced below.

Part I: Knowledge transfer in networks – within-firm analysis

Innovative knowledge has been identified as the most valuable asset of an organization and a key source for sustained competitive advantage (Grant 1996; Teece *et al.* 1997). Yet innovative knowledge is also commonly viewed as one of the most difficult resources to manage (Hansen *et al.* 2005). This dissertation therefore starts with an analysis of the contribution of different network dimensions, the formal and the informal network, to the transfer of innovative knowledge. Subsequently part I addresses cross border innovative knowledge transfer by zooming in on both cross-unit as well as cross-hierarchical collaboration.

Rich ties

To better understand the innovative knowledge transfer within organizations chapter 2 discusses the role of multiplex ties. Several innovation studies have shown that the informal contacts in organizations are the main or even only conduit for transfer of innovative knowledge. This chapter investigates the less highlighted role of formal network contacts in innovative knowledge transfer at two separate organizations. Although the first conceptual comparisons between the separate contributions of formal and informal relations have recently attracted some scholarly attention (Gulati and Puranam 2009), a direct empirical comparison has not been undertaken in the literature so far. Conceptually and empirically identifying formal

and informal networks as co-existing within a firm, we determine whether the involvement of individuals in either of these different networks explains their active role in innovative knowledge transfer. Based on empirical data collected at two separate companies, we additionally explore the effect of a combination of a formal tie and an informal tie to knowledge transfer beyond the effect of either in isolation. Research in different settings has found that ties that combine multiple dimensions of a relation between two concrete individuals can have a substantial and qualitatively different effect from the effects of their constituting elements (Burt 1984; Smith-Doerr *et al.* 2004). The specific effects on innovative knowledge transfer had not been studied empirically yet.

Bridging horizontal and vertical boundaries

In chapter 3 we examine the role of cross-hierarchy and cross-unit ties for innovative project teams. These teams typically consist of people with expertise from diverse backgrounds and different organizational units. Project teams form a typical collaboration form within organizations that caters to innovation driven temporal activities (Wheelwright and Clark 1992). Teams may have horizontal ties to other teams or business units and vertical ties to other hierarchical levels. If and how such ties influence team performance has been little researched however. Based on empirical data collected at a at a leading European financial service provider we distinguish between vertical cross-hierarchy and horizontal cross-unit ties, a distinction largely ignored in prior research. This chapter provides evidence for the claim that both types support team performance, but in their own distinct ways. Where horizontal ties are commonly linked to diversity of information, vertical ties might result in greater knowledge and resourcefulness as well as political support. Furthermore we investigate the effect of concentrating horizontal cross-unit and vertical cross-hierarchy ties among a small number of team members versus situations in which these ties are maintained by a large set of team members.

Part II: Individual network antecedents and intra-organizational innovation

In chapter 4 and 5 we take the individual employee as the focus of our investigations. By understanding the individual antecedents of network members,

insights are to be gained on how to effectively intervene in social networks to enhance intra-organizational innovation capacity. As such we respond to recent appeals for further research on the influence of structural social network characteristics in organization research (Borgatti and Halgin 2011) and provide strategic guidance for intra-organizational structural compositions by means of innovation policy directed at the individual level.

Individual motivation

Explanations of knowledge sharing within organizations emphasize either personality variables such as motivation or network-related structural variables such as centrality. Little empirical research examines how these two types of variables are in fact related: how do extrinsic and intrinsic motivation explain the position that an employee entertains in a knowledge sharing network within an organization? In chapter 4 we therefore look at the motivational attributes of network members at a multinational electronics and engineering company and integrate the structural characteristics known to be implicated in knowledge transfer with two motivational perspectives. Hereby we are combining elements from the social network literature and organization literature. It is here that we examine how motivation might explain how employees may be more centrally located in the knowledge transfer network or might be engaged more in inter-unit knowledge transfer.

Network brokering roles

In chapter 5 we further our research at the individual level, but this time we focus on the different roles individuals fulfill within the intra-organizational innovation network. Although many companies are aware of the benefits to be reaped from tapping into and exploiting technological knowledge that resided beyond their own research and development structures, many are failing because they neglect to ensure that these outside ideas reach the people best equipped to exploit them within the organization. The research presented in this chapter is driven by these facts. Based on our observations at a number of leading European and North American companies in a variety of industries, we argue that by understanding the roles of two types of innovation brokers – 'idea scouts' and 'idea connectors' – in the innovation process and by utilizing their talents effectively, managers can preside over major improvements in the conversion of external knowledge into innovative outcomes. It

is in this chapter that we draw up a typology of these two crucial roles and elaborate on their mutual dependency to realize an organization's innovation potential.

Part III: Network restructuring and the dimension of time

Coordination (and the communication it implies) is central to the very existence of organizations (Kleinbaum *et al.* 2008, p.3). Surprisingly, the effect of coordination by deliberate intervention by management in general, and to stimulate innovative activities in particular, has remained largely under-explored in organization and network literature (Okhuysen and Bechky 2009; Tortoriello 2007; Balkundi and Kilduff 2005). In chapter 6 and 7 we consolidate our earlier findings on the network level and on network antecedents of the individual actor. We relate our earlier findings to two separate and distinct, yet commonly applied situations of purposeful managerial intervention. Investigating a simple formal taskforce intervention (Chapter 6) as well as a major corporate restructuring trajectory (Chapter 7) at a leading European financial service provider at separate time intervals, we gain insights in the antecedents of network restructuring over time.

Formal taskforce intervention

Management may seek to stimulate involvement of employees in innovation activities by purposeful intervention (Dieh and Stroebe 1987; DeChurch and Marks 2006). Surprisingly, given that purposeful intervention in an organization is one of management's core activities, its effects in general and for innovation in particular have, to date, hardly received attention of academic research (Marone 2010; Okhuysen and Bechky 2009). Chapter 6 studies the longitudinal effects of a 'simple' formal intervention by management by the establishment of a typical temporary middle-management taskforce to boost involvement of individual employees with innovation at a leading European financial service provider. Individuals' position in an organization's innovation network and the number and diversity of ties maintained are known to induce innovative performance. Combining quantitative and qualitative analyses in a multi method study, we study how the formal intervention impacts these characteristics of individuals in the innovation network. By studying the organizational network prior and post intervention we gain insights in the degree to

which formal intervention stimulates newcomers, those that had no prior involvement within the firm with innovation, to enter the innovation arena.

Corporate restructuring by downsizing

A more drastic intervention constitutes corporate restructuring by means of downsizing. Although downsizing once was viewed as an indicator of organizational decline, it now has clearly established itself as a prime mechanism of corporate restructuring (McKinley *et al.* 1995; Fisher and White 2000). While at times believed to be unavoidable, corporate reorganization by downsizing is widely believed to affect innovation negatively. The exact effects of corporate downsizing as a means to management to revitalize an organization, has remained rather underexplored however. Chapter 7 develops a longitudinal social network perspective to study the resilience of the innovation network following corporate downsizing. Studying corporate downsizing at a large financial service organization over a period of a year, we gain insight in the degree to which downsizing, as a particularly radical form of organization restructuring, affects several organizational network characteristics that have been identified in earlier research as critical for innovative intra-organizational activity.

As a summary of the elements introduced in the different chapters outlined above, figure 1.1 provides an overview of the main relationships addressed in this dissertation.

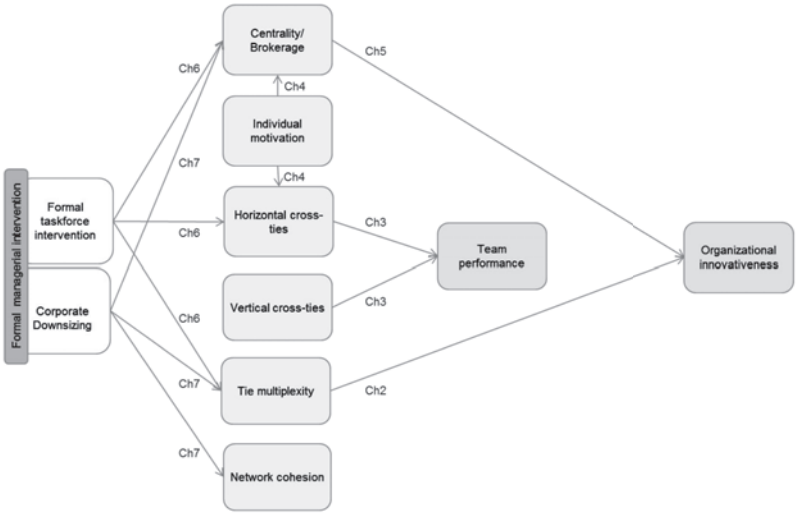

Figure 1.1: Overview of the main elements and relationships in this dissertation

Part I:

Knowledge Transfer in Networks – Within-Firm Analysis

Chapter 2

Rich Ties and Innovative Knowledge Transfer within a Firm[2]

2.1 Introduction

Knowledge is frequently considered to be the most valuable asset of an organization and a key source for sustained competitive advantage as it allows for innovation (Grant 1996; Teece *et al.* 1997). Yet, at the same time, it is one of the most difficult resources to manage. As knowledge usually is spread throughout the organization, it may not be available where it might best be put to use (Cross *et al.* 2001; Hansen 1999; Hansen *et al.* 2005; Szulanski 1996). Scholars have emphasized that effective transfer of innovative knowledge between employees within an organization indeed increases the organization's innovativeness (Tushman 1977; Hansen *et al.* 2005). Thus, transfer of knowledge within the organization has received considerable attention in the literature (Hansen 1999; Foss *et al.* 2010).

Knowledge transfer within a firm has frequently been studied from a network perspective, with researchers on one hand aiming to map the network in which innovative knowledge is transferred, i.e. the innovation network (Rodan 2010; Cross and Prusak 2002; Stephenson 2006) and on the other hand aiming to identify

[2] This chapter is currently under 2nd round of review at *Strategic Organization* as Aalbers, H.L., Dolfsma. W.A. and Koppius, O. (2012). "Rich Ties and Knowledge Transfer within Firms". A previous version of this chapter was presented at the International Sunbelt Social Network Conference 2009, California (USA), as Aalbers, H.L., Koppius, O. and Dolfsma, W.A. (2009). "The Strength of Rich Ties: the Role of Multiplexity in New Business Development Networks".

the network that facilitate such knowledge transfer. Conceptually and empirically identifying formal and informal networks in a firm, we determine whether the involvement of individuals in these networks, separately and in 'multiplex' combination, explains their active role in innovative knowledge transfer. Most studies emphasize the importance of informal ties for effective knowledge transfer (Borgatti and Foster 2003; Hansen 1999; Krackhardt and Hanson 1993; Reagans and McEvily 2003; Rizova 2007), pointing to its role in connecting employees – 'the water cooler effect'- and its importance in establishing trust between employees. As a consequence, the contribution of informal ties dominates innovation management research (Foss *et al.* 2010; Gulati and Puranam 2009). We believe that this is too limited a view on the role of networks in knowledge transfer for two reasons. First, organizations consist of both formal and informal networks. Although some older studies point to formal ties potentially contributing to knowledge flows in organizations (e.g., Darr *et al.* 1995; Nonaka 1994), formal networks have rarely been investigated in detail and even when they have been, they are often equated with the organization chart (Cross and Prusak 2002; Foss *et al.* 2010; Krackhardt and Hanson 1993; see Hansen *et al.* 2005 for an exception). This, as we will argue below, is a very limited view on formal ties. Second, networks in organizations overlap. In many cases, ties are multiplex: employees will share both a formal and an informal tie. This multiplexity results in a qualitatively different interaction between employees than either a formal or informal tie alone (Burt 1984; Smith-Doerr *et al.* 2004), which is likely to affect knowledge transfer.

Our research contributes two important findings to the literature. First, using broadly accepted and well-founded definitions and measures, we find that formal relations contribute at least as much to knowledge sharing as informal ones. This is a vindication for the role of formal structures – defined to include the organizational chart as well as formally mandated yet temporary quasi-structures (Brass 1984; Schoonhoven and Jelinek 1990) – for knowledge transfer. Research in the past tended to emphasize the role of informal networks for knowledge sharing, yet managers may not be in a position to readily influence informal networks (Cross *et al.* 2002). Shaping formal networks *can* indeed successfully contribute to knowledge transfer to improve or sustain a firm's competitive position (cf. Rizova 2007). Although a first qualitative comparison between the separate contributions of formal and informal relations has recently attracted some scholarly attention (e.g., Gulati and Puranam

2009), a comprehensive, direct empirical comparison has not been undertaken in the literature so far.

Second, and perhaps more importantly, in addition to analyzing how the formal and the informal networks contribute to knowledge-sharing separately, we determine their combined, multiplex contribution to innovative knowledge transfer. When we combine informal and formal ties into multiplex or what we call *rich* ties, we find that rich ties affect knowledge sharing between individuals much more than formal-only and informal-only ties.

Our separate but identical network analyses in two different firms (cf. Cross and Cummings 2004; Levin and Cross 2004) allows us to submit these two robust findings that are of particular importance for the strategic organization of firms striving to sustain their innovativeness in a turbulent environment (cf. Janssen *et al.* 2006).

2.2 Innovative knowledge transfer in organizations

A central insight from the network approach to knowledge transfer is the observation that relations between individuals within an organization play a significant role in knowledge transfer (Allen 1977). Monge and Contractor (2001, p.440) define a network as "the patterns of contact between communication partners that are created by transmitting and exchanging messages through time and space." While many different kinds of relations can be distinguished, a broadly accepted distinction is between formal networks of organizationally mandated relations on the one hand, and informal networks of emergent relations on the other hand (Allen and Cohen 1969; Allen 1977; Ibarra 1993; Gulati and Puraman 2009). These two networks can be argued to be the prime ways in which people interact in an organization (Blau and Schoenherr 1972; Blau and Scott 1962; Simon 1976). Involvement in these networks of ties would also, arguably, make individuals more likely to transfer innovative knowledge in a firm.

Formal relations

Formal relations have been a historical focus of research among management scholars and sociologists (Aiken and Hage 1968; Blau and Schoenherr 1972), albeit without a strong emphasis on transfer of innovative knowledge. Research on

formal structures – "the planned structure for an organization" (Simon 1976, p.147) – focuses on relations as stipulated by corporate management, most prominently in the organizational chart (Kilduff and Brass 2001). In line with earlier network studies (e.g., Mehra *et al.* 2001; Brass and Burkhardt 1992; Gulati and Puraman 2009) we define the formal relations, which together form the formal network, as the prescribed roles and linkages between roles, set forth in job descriptions and reporting relationships. Formal structures are not limited to the organizational chart, however, and include quasi-structures such as committees, task forces, teams, and dotted-line relationships that are formally mandated by the firm as well (Schoonhoven and Jellinek 1990; Ibarra 1993). Even though the relationships in these quasi-structures may be more temporary than relationships represented by the organizational chart, they are mandated by the firm and an important part of the execution of daily operations in the firm (Adler and Borys 1996).

Foss (2007, p.37) has argued that when knowledge processes and innovative knowledge transfer are discussed formal organization are 'seldom if ever integrated into the analysis' or are even neglected in recent studies. Indeed, since the review by Damanpour (1991), the formal organization has not been the subject of much research in the field of innovation studies. Some scholars have argued that formal relations or networks hamper creativity and demotivate individuals (Krackhardt and Hanson 1993; Robertson and Swan 2003). Others have indicated that formal networks reduce the autonomy of individuals involved in complex, non-routine activities (Tsai 2002). Formal networks have been claimed to reduce the flexibility of an organization to adapt to new circumstances and challenges.

However, formal structures, including quasi-structures, are also relatively transparent. They allocate responsibility, and may thus prevent conflict and reduce ambiguity (Adler and Borys 1996). When an organization grows in size, formal structure is required to stay in control and allow for specialization (Adler and Borys 1996; Blau and Schoenherr 1971). The location of expertise is more easily determined and obtaining resources may only be possible by formal mandate. Thus, the formal structure dictates to a large degree who interacts with whom (Damanpour 1991; Gulati and Puranam 2009) and it is this formal interaction that provides the foundation for innovation. As two employees start to exchange simple, routine knowledge, this builds shared understanding and absorptive capacity at the dyadic or tie level (Gabarro 1990; Lane and Lubatkin 1998), which can subsequently facilitate

transfer of more complex, innovative knowledge. In innovation management, the mandated involvement of employees in temporary project teams has been much studied in a more recent past, and shown to contribute to innovative performance (e.g., Cooper and Kleinschmidt 1986).

Informal relations

Blau and Scott (1962) observed that it is impossible to understand processes within the formal organization without investigating the influence of the informal relations within that organization. The network of informal relations refers to the "interpersonal relationships in the organization that affect decisions within it, but either are omitted from the formal scheme or are not consistent with that scheme" (Simon 1976, p.148). Informal networks are the contacts actors have with others within the organization that are not formally mandated. Informal ties are discretionary or extra-role in the sense of being initiated by the individuals themselves; failing to maintain such a tie will not be a matter of negative evaluation by a superior (Gibney *et al.* 2009). The informal relations that make up the informal network are the emergent patterns of individual behavior and interactions between individuals within organizations, commonly believed to be based on shared norms, values, and beliefs (Smith-Doerr and Powell 2005; Gulati and Puranam 2009). Some have observed that when organizational issues in relation to knowledge processes are discussed in the management literature, "organization primarily means informal organization" (Foss 2007; Foss *et al.* 2010). Culture, trust and communities of practice, rather than formal governance mechanisms, are then referred to.

The informal network provides insight into the general way 'things are getting done' within the organization, possibly by-passing and sometimes undermining the formal structure (Lazega and Pattison 1999; Schulz 2003). When communication via the formal network takes too long, or when the relations required to get certain things done have not been formally established, the informal network ('the grapevines') may come into play as it cuts through the formal structures and function as a 'communication safety net' (Cross *et al.* 2002). Even though an informal network can be elusive and intransparent and can lead to clique formation where new knowledge upsetting a status quo will not be accepted, Albrecht and Ropp (1984) suggest that employees tend to transfer new ideas with colleagues in their informal network first and Hansen (2002) argues that informal relations allow one to tap into new

knowledge more easily. Informal relations provide the opportunity for information and knowledge to flow in both vertical and horizontal directions, contributing to the overall flexibility of the organization (Cross *et al.* 2002). Informally, individuals may be willing to exchange information and favors beyond what the organization has formally mandated them to do (Dolfsma *et al.* 2009). Such what might be called extra-role behavior can sometimes be contrary to formal instructions and expectations, but has been indicated to benefit the individuals involved and the organization when occurring (Bouty 2000). Informal ties have been argued to be the primary basis for the creation of interpersonal trust, which is necessary for innovative knowledge transfer to take place in practice (Szulanski *et al.* 2004).

Defining formal relations as those relations that are designed and mandated by the organization, and informal relations as emergent and discretionary patterns of inter-personal interaction, we suggest the following proposition:

> ***Proposition 1:*** *Both formal as well as informal ties contribute to transfer of new, innovative knowledge within an organization.*

Multiplexity

Few studies include these different kinds of networks in a single analysis, certainly not in the context of innovative knowledge transfer (cf. Foss *et al.* 2010). A relation between two individuals can, but need not have both a formal dimension as well as an informal dimension. Lazega and Pattison (1999) and Rank *et al.* (2010) emphasize the importance of multiple, possibly interconnected networks in understanding organizational structures. If a relation between individuals combines several dimension of interaction relation into a single tie, it is considered multiplex (Burt 1983, p.37; Robins and Pattison 2006). Multiplexity has been shown to produce beneficial results to the individual, personally and professionally, and to his social environment such as a firm (Ibarra 1995; Burt 1984; Smith-Doerr *et al.* 2004). Multiplexity does not indicate, conceptually nor empirically, the aggregation of different social networks in a specific social setting, but rather that "quite different networks exist simultaneously within the same organization" (Lincoln and Miller 1979, p.182; Robins and Pattison 2006; Smith Doerr and Powell 2005). Networks may thus relate with each other, but remain conceptually separate. Multiplexity has been related to such issues as the increased intimacy of relationships (Minor 1983),

greater temporal stability of relationships (Minor 1983; Rogers and Kincaid 1981; Ibarra 1995), reduction of uncertainty (Albrecht and Ropp 1984), higher status (Albrecht and Ropp 1984), heightened performance (Roberts and OReilly 1979), and better diffusion of information within networks (Minor 1983).[3]

We focus, as argued above, on *combined* formal and informal relationships, since these two different ties best typify workplace relationships (e.g., Gulati and Puranam 2009; Rank *et al.* 2010). Lazega and Pattison (1999) found that informal relations augment formal relations between individuals in getting things done. By combining different relational aspects such multiplex relational ties may transform into *rich* ties: when individuals are connected in a number of different ways, more as well as better and more reliable information tends to be exchanged (Sias and Cahill 1998). People may be in a better position to determine and interpret how someone will behave in one context if his behavior and attitude is known from a different context, thus reducing uncertainty. Role ambiguity is significantly reduced in case of multiplexity as people understand better what is expected of them (Hartman and Johnson 1979). A relation of one kind may keep in check the negative side-effects of a relation of a different kind (Marsden 1981). Multiplex relationships are characterized as more intimate, voluntary, supportive and durable ties and thus trust may grow (McCallister 1995). In case of multiplex ties between individuals in a relation, each tie is also likely to be stronger, and social capital between the individuals will be larger (McEvily *et al.* 2003). Therefore, multiplex, rich ties combine essential aspects that are necessary for the transfer of innovative knowledge.

In the context of our study that focusses on innovation activities on innovation activities by private firms, the formal component of a multiplex, rich tie builds the shared purpose and understanding and provides the mandated resources necessary to be *able* to share complex, innovative knowledge on one hand. On the other hand,

[3] Albrecht & Hall (1991) refer to the *content* of the knowledge exchanged, rather than the kind of network relation individuals are involved in, when discussing multiplexity. They find that multiplexity in the sense of transferring different kinds of knowledge in a single relation between two persons contributes to transfer of innovative knowledge. By defining multiplexity in terms of the content of the knowledge transferred, a comparison of findings across contexts (generalizability) is problematic. In this paper we, thus, follow the recent social networks and management literatures in defining multiplexity in terms of different aspects of a relationship that can connect employees.

the informal component of a multiplex, rich tie builds the trust that is necessary to be *willing* to share complex, innovative knowledge. We submit that the multiplex combination of formal and informal relations in a firm's network structure in the form of rich ties proves qualitatively different from formal ties or informal ties by themselves as foundation for innovative knowledge transfer. We thus submit the following proposition:

> ***Proposition 2:*** *Transfer of new, innovative knowledge is more likely to occur when actors share a multiplex ('rich') tie (i.e. a tie in both the formal and informal network), compared to having a formal-only tie or an informal-only tie.*

2.3 Method

Organizational setting

Our study is based on findings at two separate companies, one a subsidiary of an European multinational electronics and engineering conglomerate (Alpha), the other a leading financial service provider (Beta). The two companies selected differ in terms of size, organizational design, and type of industry to indicate the robustness of our findings. Alpha company employs worldwide over 400,000 people. Over 6.8% of revenues are spent annually on R&D by this high-tech firm. The subsidiary studied, operating since the late 19th century, employs over 4000 employees. Revenue generated by this subsidiary is equivalent to some 6.5% of total revenue for the conglomerate. Beta Company is one of Europe's largest and most innovative payment processors, leading the market for secure payments and card processing solutions. With an annual processing volume of almost 7 billion payments and the switching of 1.9 billion POS and ATM transactions, the company's market share within the Eurozone is well over 10%, employing 1500 employees. Access to both companies was negotiated through the senior innovation managers, in each case operating directly under the supervision of the board of directors.

Alpha company is organized according to a divisional structure (Mintzberg 1980). Recently, the company shifted towards offering integrated solutions to its customers, based on its technical competencies that cross division boundaries. The company has reorganized its activities according to a number of strategic

multidisciplinary themes. We focus on one specific theme: transportation – a theme given high priority by corporate management. Beta Company is organized as a machine bureaucracy (Mintzberg 1980). Activities at Beta Company are focused around the theme of innovative payment methods, which is receiving significant attention by corporate management.

Focusing on knowledge transfer related to a single theme offers two advantages. First, reliability of the data gathered is enhanced as the context for the questions is clearer and closer to the respondents' day-to-day activities. Secondly, identifying a clear theme allows for a precise specification of the boundaries of the network to be investigated (Laumann *et al.* 1983). Several interviews with relevant senior management revealed which divisions are involved in innovative activities with a view to the data collection process.

Data collection

We collected the data through semi-structured interviews and a survey to gather information on the networks and their participants. Interviews served two purposes: first, to become familiar with both organizations and, second, to serve as the first round in our snowball sampling procedure. Snowball sampling is especially useful when the target population is not clear from the beginning as, e.g., when it cuts across unit boundaries (Wasserman and Faust 1994). The target population emerges in several rounds of surveying, where contacts mentioned in a round determine who should be approached as a respondent in a subsequent round. To exclude the risk of ignoring 'isolates', individuals who do possess relevant knowledge to a particular subject but who are not well connected, we targeted respondents that were generally acknowledged as key figures in the innovation communities under investigation with diverse backgrounds in terms of department affiliation, tenure and hierarchy in our first round (Rogers and Kincaid 1981). Starting with a single or a limited number of relatively similar individuals when gathering data on who is involved in a network might lead to a situation in which some might be erroneously ignored. Starting to survey managers from key units, for instance, might result in a situation where less senior individuals, or individuals from units only peripherally involved, are left out by error. Through consecutive rounds of respondent identification until no further individuals were listed by respondents or management, we can be sure to have identified all relevant respondents. See Table 2.1 and Figure 2.1 for descriptives.

Thus there is no boundary specification problem (Laumann *et al.* 1983; Marsden 1990, 2002). Beyond the first round, a digital survey was distributed, accompanied by a personalized cover email co-signed by the senior innovation manager to increase response rates. We did not set a maximum number of contacts respondents could enter as that could unduly affect network structure (Friedman and Podolny 1993). To reduce ambiguity, network questions were formulated in the native language. Respondents who did not reply initially were personally interviewed, resulting in an overall response rate of 96 and 92 percent respectively for Alpha and Beta Company.

Measures

It is increasingly recognized that the organization chart is a poor indicator of interpersonal relations under today's organization dynamics (Krackhardt and Hanson 1993). An organization chart is often focused more on hierarchical, vertical reporting relations, ignoring formally mandated horizontal relations or more temporary quasi-structures such as innovation project teams. When studying knowledge transfer in an organization, this is a shortcoming. We measured the formal (workflow) network by asking respondents with whom they interact to successfully carry out their *daily activities* within the organization that were prescribed or mandated by the organization (Mehra *et al.* 2001; see also Brass 1984; Brass and Burkhardt 1992; Cross and Cummings 2004; Whitbread *et al.* 2011). The explicit focus is on existing products and services that have already been developed, or relations that had already been established and follow from the respondent's role or position in the organization. Following Ibarra (1993) and Brass (1984) we measured the informal network by asking respondents with whom they discussed what is going on within the organization to get things done that are of personal relevance to them (cf. Mehra *et al.* 2001; Smith-Doerr *et al.* 2004), allowing us to capture the 'organizational grapevine'. This informal network provides insight into the general way 'things are getting done' within the organization (Umphress *et al.* 2003), often by-passing the formal communication structure (Schulz 2003). These questions are referred to in social network analysis as 'name generator questions' since their purpose is to find precise information about the shape and size of a network. Formal relations are thus designed or mandated by the organization, while informal relations are emergent, discretionary or extra-role. Employing these well-founded name generator questions yields matrices containing data of who is related with whom. Our third, independent

variable, for the second part of our analysis, is multiplex ties. By rearranging the information obtained by the name generator questions above matrices containing data of purely formal, purely informal, and multiplex (combined or 'rich') ties were constructed.

The dependent variable is the innovative knowledge transfer network, where we asked individuals with whom they exchange *new* ideas, *innovations* and substantial *improvements* to products and services that are not part of their day-to-day activities (Rodan 2010; Stephenson 2006; Cross and Prusak 2002, p.107). Whereas the name generator question for the formal network measures the connections resulting from exchange of routine issues and day-to-day information, the name generator question for the innovative knowledge transfer network asks about the transfer of new or complex knowledge that was specifically *not* perceived as related to the ongoing business of the organization (Rodan 2010). In the first rounds of interviews with respondents, in the reminder interviews to increase the response rate to one that is required for network analysis, and in interviews with management it was established that respondents were keenly aware of the differences between the three kinds of contacts that they were asked about.

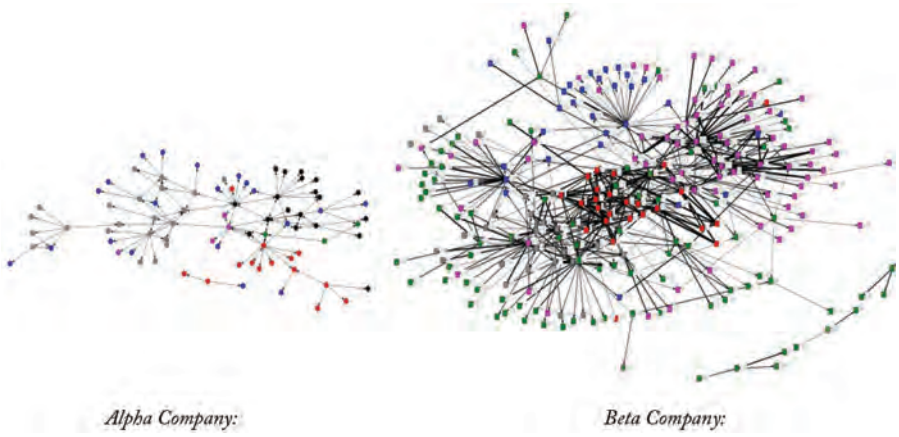

Figure 2.1: The innovation networks at Alpha (n*=83) and Beta Company (n*=241)
** Not all actors included in the survey hold a tie in the innovation network.*

Analysis

We employ quadratic assignment procedure (QAP) regression as our statistical method. This method is commonly used in social network analysis for analyzing dyadic data sets, i.e. data sets where pairs of entities are analyzed, and provides a specific type of permutation test which keeps intact the dyadic data structure under varying permutations (Borgatti *et al.* 2002; Borgatti and Cross 2003; Simpson 2001; Krackhardt 1987, 1988). A conservative estimation procedure, QAP semi-partial regression solves the issue of auto-correlations in network data. By permutation of rows and columns of the original data matrix for the dependent variable, as a sampling procedure, the QAP procedure re-estimates the original regression model repeatedly to determine how likely it is that the observed network structure could have evolved purely by chance.

2.4 Results

Table 2.1 shows the frequency of tie types in our sample in relation to knowledge transfer for Alpha and Beta Company – for a visual presentation, please refer to Figure 2.1. The majority of ties are multiplex, rather than formal- or informal-only, even though the underlying formal and informal networks measure separate networks that are theoretically independent and methodologically different as argued above. Such frequent co-occurrence of ties was found in other studies as well (Gulati and Puranam 2009; Hansen *et al.* 2005; Smith-Doerr *et al.* 2004). Informal-only ties are, remarkably, perhaps, much less common than formal-only ties.

	Alpha Company (114 individuals*)		**Beta Company** (281 individuals*)	
	Number of ties	**Of which: corresponding tie in innovation network**	**Number of ties**	**Of which: corresponding tie in innovation network**
Multiplex tie (‡)	116	91	379	318
Formal tie only	69	26	66	34
Informal tie only	11	6	36	18

Table 2.1: Descriptives – Frequency of tie types

‡Formal and informal tie overlapping between same actors;

** Count of individual actors based on prescence in any of the three network types, hence deviating from number of actors depicted in figure 2.1 (innovation only).*

Table 2.2 presents the results of our analysis of the influence of different kinds of relations on innovative knowledge transfer. Models I and II separately analyze the influence on knowledge transfer of the informal and the formal relations respectively. In model III we include both the formal and the informal networks as independent variables to explain the innovative knowledge transfer network as our dependent variable. Results in Table 2.2, models I and II, show that both the formal and the informal relations each, respectively, separately explain innovative knowledge transfer in an organization. Including both these two networks in model III also indicates that formal and informal relations contribute to innovative knowledge transfer within an organization. Proposition 1 is therefore supported. What may be remarkable is that betas for the formal network appear to remain larger than for the informal network in models I, II and III.

Type of relation	Model-I	Model-II	Model-III	Model-IV ‡
Alpha Company				
Informal	0.704***	–	0.369***	0.137***
Formal	–	0.722***	0.444***	0.283***
Multiplex	–	–	-	0.697***
R^2 (adj.)	0.50	0.52	0.58	0.58
Beta Company				
Informal	0.803***	–	0.329***	0.215***
Formal	–	0.844***	0.572***	0.155***
Multiplex	–	–	–	0.836***
R^2 (adj.)	0.64	0.71	0.75	0.77

Table 2.2: Innovative knowledge transfer in organizations – QAP regressions

*QAP semi partial regressions (UCINET; Borgatti et al. 2002). Coefficients standardized; 5000 permutations; *** 1% significance. ‡ Formal-only and informal-only relations* ***net*** *of multiplex relations.*

Next, we separate the multiplex ties from the non-multiplex ties – resulting in formal-only and informal-only relations and a separate set of multiplex ties. Re-ordering the data allows us to isolate the effect of multiplexity. Multiplex ties are entered in regression model IV together with formal-only and informal-only ties. Model IV shows that for both cases studied, multiplex ties are the single most

important type of tie for innovative knowledge transfer. Thus, for the purpose of knowledge transfer, multiplex or, as they may be called rich ties, combining both formal and informal aspects in a relation between two individuals are thus particularly fruitful for innovative knowledge transfer. Proposition 2 is thus supported as well. A comparison between the findings of models III and IV suggests, but does not statistically prove, that part of the explanatory power that loaded onto either the formal or the informal network in Model III turns out not to actually be a consequence of a formal-only or an informal-only tie, but rather the consequence of a multiplex tie.[4]

Explanations of innovative knowledge transfer within a company should thus focus on both informal and particularly formal relations, and additionally on how these two interrelate to constitute 'rich', or multiplex ties.

2.5 Conclusions and implications

Knowledge transfer is necessary to increase the innovative potential of an organization, contributing to its dynamic capabilities in a turbulent economy (Janssen *et al.* 2006). In the literature on innovative knowledge exchange within an organization a network perspective is often adopted similar in nature to what our study does. This analysis has resulted in a number of important academic and managerial insights. Informal relations in particular have been emphasized as contributing to knowledge transfer (Cross *et al.* 2002; Stevenson and Gilly 1991). Responding to recent calls for further empirical evidence in this area (Gulati and Puranam 2009), our study is the first to empirically compare how different networks contribute to knowledge transfer within a firm (Hansen and Lovas 2004; Hansen *et al.* 2005). We find that it is not just informal relations that contribute to knowledge transfer: formal relations have a substantial and perhaps even more important role to play as well.

[4] For the purposes of our analysis QAP regressions are most appropriate (Borgatti *et al*. 2002). Due to the dyadic permutation procedure that QAP regression involves, no statistical comparison of weighted effects between the different models we present can be undertaken, nor does this analysis allow for inclusion of controls at the individual node level.

Our second, and perhaps most important contribution, is to point to the importance of multiplexity of ties for transfer of innovative knowledge. Relations that combine formal as well as informal aspects into a single relation between two persons have a genuinely distinct and significantly positive effect on innovative knowledge transfer within organizations. Such ties thus are *rich* not just because multiple dimensions of relations are incorporated in a single relation, but they are also *rich* because they contribute significantly to innovative knowledge transfer and thus the maintenance of a firm's competitive position. Rich ties work better for innovative knowledge transfer than purely-formal or purely-informal ties do. Knowledge transfer effects that in previous studies have been attributed to informal (or formal) networks only, may in fact need to be attributed to multiplex, rich ties.

Since formal relations may provide the basis on which informal relations develop (Han 1996), and since formal relations are more purposefully malleable than informal ones, management can actively seek to enhance a firm's dynamic capabilities by stimulating the transfer of innovative knowledge through shaping the formal structures in their organization. Management can influence knowledge transfer more purposefully than much previous research emphasizing informal relations has led scholars and managers to believe.

Limitations

More research is required that elaborates on the research we present here. Even though we included all individuals involved in the subject area in both organizations that were studied, we have only studied two firms. While this may surprise scholars not familiar with social network analysis, for social network analysts this is known not to be problematic (Cross and Cummings 2004). Secondly, the organizations we studied are part of larger multinational structures, and, much like other large firms that have similar structures, maintain a somewhat formal organizational culture (e.g., Pugh *et al.* 1969). Highly skilled professionals in knowledge-intensive organizations are less likely to be amenable to formal authority claims, especially when involved in the discretionary or extra-role activity of transfer of innovative knowledge. Qualitative observations during the field studies confirm this. The similarity in outcomes for the analysis of the different two firms selected also indicates that our findings are not an artifact of the firms chosen to be included in the analysis. Thirdly, the substantive contribution of innovative knowledge transferred to actual innovation

and subsequently to firm performance we unfortunately cannot analyze here. This needs to be explored further, taking into account the content of what is transferred as well, in future research. Finally, the multiplex or rich synergy between formal and informal ties would ideally be investigated over the course of an extended period of time, where extensive analysis of quantitative as well as qualitative information would be needed.

Chapter 3

Vertical and Horizontal Cross-Ties: Benefits of Cross-Hierarchy and Cross-Unit Ties for Innovative Project Teams[5]

3.1 Introduction

Project teams have long been an essential instrument to accomplish organizational objectives (Ancona and Caldwell 1992a; Blindenbach-Driessen *et al.* 2010) and have received considerable attention in the literature (e.g., Haas 2010; Kratzer *et al.* 2010; Leenders *et al.* 2007a; Markham 1998). Companies tend to organize their innovation endeavors in multi-disciplinary project teams (Griffin 1997). Such teams need to deal with increasingly complex, technical knowledge from different backgrounds. Despite the importance of new product development as an engine for innovation, the failure rate of innovative projects is high (e.g., Sivadas and Dwyer 2000). Approximately one in ten product concepts succeeds commercially (Cooper *et al.* 2004). Much can be gained, therefore, when innovation projects can be made more successful. Since innovation projects are typically performed by innovation teams, the innovative success of such teams is directly related to the innovative success of the project. Project team functioning has been a focus of attention in the

[5] This chapter has been accepted for publication in *Journal of Product Innovation Management* as Aalbers, H.L., Dolfsma W.A and Leenders R.Th.A.J (2012, forthcoming) "Vertical and Horizontal Cross-Ties: Benefits of Cross-Hierarchy and Cross-Unit Ties for Innovative Project Team". A previous version of this paper was presented at the 2011 DRUID conference, Copenhagen, Denmark and included in the conference proceedings.

literature (Hansen 1999; Tsai 2002; Baer *et al.* 2010). This has led to the insight that access to diverse knowledge and information provided by bridging or cross-ties may be critical for project team performance and innovativeness (Blindenbach-Driessen and Van den Ende 2010; Leenders *et al.* 2007b). A project team's access to diverse knowledge and insights is likely to yield better informed decisions and should help teams benchmark their activities and enhance their functional expertise (Haas 2010; Roth and Kostova 2003; Szulanski 1996).

In this chapter we focus on what we call 'cross-ties', i.e., the external ties maintained by a team within the company, to study what the contribution of such ties is to project performance (Ancona 1990; Ancona and Caldwell 1992a; Marrone *et al.* 2007). Research on cross-ties has advanced our understanding of what determines the (innovative) performance of teams, yet what kind of cross-ties will have what effect has been left to further research (Carlile 2004). Ancona and Caldwell (1992) do signal that different kinds of externally oriented activities may exist in teams but are very limited in their conceptualization of them. In this chapter, we conceptually distinguish between horizontal and vertical cross-ties and study how each is related to innovation project performance. This both significantly adds to the conceptualization in the classic work of Ancona (Ancona 1990; Ancona and Caldwell 1992a) and presents original empirical support.

We will argue that engaging in information-sharing or communication in the innovation process (McQuiston and Dickson 1991) can occur both through horizontal cross-unit ties (crossing unit-boundaries) and through vertical cross-hierarchy ties (crossing hierarchical levels). Horizontal cross-ties provide a team with diverse information and knowledge that make it possible for the team to be innovative. Vertical cross-hierarchy ties, on the other hand, mainly provide access to (political) influence that assists the team by finding support and resources (Atuahene-Gima and Evangelista 2000, p.1269; Haas 2010). Current studies center on the information bridging aspect of (horizontal) cross-ties, focusing on the diversity of the knowledge that teams tap into. The effect of access to influential resources is little studied explicitly (except for Cross and Cummings 2004). However, the success of an innovation team in an uncertain and ambiguous environment (Frost and Egri 1991; Maute and Locander 1994) may be argued to require both horizontal cross-unit as well as vertical cross-hierarchy ties. We argue that the contribution to performance

is different between horizontal and vertical cross-ties: the first foster diversity, while the latter foster organizational support and managerial sponsorship.

Additionally we argue that concentrating horizontal cross-unit and vertical cross-hierarchy ties among a limited number of team members enhances a team's innovative performance. For successful innovation teams, horizontal and particularly vertical cross-hierarchy ties are maintained by a small number of team members rather than scattered across a large number of team members.

These findings expand the common understanding in the literature on what determines team level performance and substantially elaborate on earlier studies that provided a categorization of group boundary spanning activity in terms of strategic focus (Ancona and Caldwell 1992, 1990a; Ancona 1990). These earlier studies did not differentiate between a horizontal or vertical orientation as important dimensions of boundary spanning activity.

Section 2 discusses theory and develops propositions, whereupon Section 3 discusses method, data and research setting. Following this, Section 4 presents results, while Section 5 concludes, draws management implications, and suggests further research.

3.2 Theory and proposition development

The external connectedness of new product development teams has scarcely been studied and consequentially the effect of team members spanning boundaries on team innovative performance is largely ignored (cf. Marrone *et al.* 2007; Marrone 2010).[6] Unlike Ancona and Caldwell (1992a), we explicitly and conceptually distinguish between horizontal ties crossing unit-boundaries and vertical ties crossing hierarchical boundaries, within the firm to bridge this gap in the new product development literature. Each of these kinds of cross-ties can be expected to offer ***distinct*** benefits. In this chapter we also argue that such ties should be concentrated into the hands of a relatively small number of team members.

[6] The discussion of boundary spanning relates to but is conceptually different from the issue of the formal distance (autonomy) or physical distance (separate location) that a team maintains to the core of the organization (Wheelwright and Clark 1992).

Horizontal cross-unit ties (fostering diversity of input)

Innovation is often argued to be the epitome of non-routineness (Pasmore 1997) – the more novel a task for the team, the less it can rely on routines and existing knowledge. Isolation is likely to hamper innovation team effectiveness (Haas 2010; March 1991). Many of today's challenges for firms are non-routine. Through effective communication, using the knowledge developed by others outside the team, teams obtain previously unavailable information and can then develop new knowledge and insights (Sethia 1995; Moenaert *et al.* 2000). When shared within the project team, the diversity of insights and knowledge benefits the overall project team's knowledge base and hence team performance (Allen 1977; Tushman 1979; Ancona and Caldwell 1992b).

For the team to be creative and develop novel and useable solutions to technical and commercial problems, interaction and cross-fertilization of ideas beyond team boundaries can be essential (Leenders *et al.* 2003). Through consultation and interaction, teams may anticipate and prevent potential weaknesses in technical and marketing solutions. Communication crossing team boundaries makes it possible to access external knowledge, to be combined into new knowledge and insight. The performance of an innovation team consequently depends in part on the team's communication effectiveness. Teams that do not communicate effectively beyond team boundaries with outside specialists may be unlikely to generate novel and feasible solutions to the multifaceted problems they face.

Literature has shown that accessing knowledge from across organizational boundaries is an important driver of innovative performance and project team success (Cohen and Levinthal 1990; Obstfeld 2005; Leenders *et al.* 2007b; Tortoriello and Krackhardt 2010). Besides bringing in their own specialized expertise, team members who maintain horizontal cross-unit ties to other business units are more likely to think and act outside of the narrow confines of their own task and project team (Duncan 1976; Floyd and Lane 2000). Having access to diverse resources stimulates creativity in itself (Woodman *et al.* 1993; Paulus 2000; Reagans and McEvily 2003). Complementary functional expertise may be brought to bear; participation in cross-unit activity by members of an innovation team increases access for the team to alternative ideas and insights (Floyd and Lane 2000).

Vertical cross-hierarchy ties (fostering influence)

Hershock *et al.* (1991) argue that continued senior management commitment and support is the single most important factor in increasing the likelihood of project team success. Vertical cross-hierarchy ties connect the team to individuals with higher status positions that have desirable influence resources such as access to funding, prestige, power, and privileged access to others in the organization.

Although the relationship between upward influencing capability and performance is not new at the individual level of analysis (Athanassiades 1973; Porter *et al.* 1981; Schilit 1986), studying the capability of upward influence at the project team level has remained largely unexplored. The limited number of studies that have researched the project level, focus on the project team leader specifically (Shim and Lee 2001) and visualize influence as flowing from a single manager to his subordinates, rather than the other way round (Tourish and Pinnington 2002).

Taking the team perspective as point of departure, we pose that besides access to a broader range of information, cross-hierarchy ties also provide a project team with the capability of upward influencing power in relation to project team performance. Vertical cross-hierarchy ties can provide the team with access to resources of a different nature than that which the team accesses through its horizontal cross-unit ties. Vertical cross-hierarchy ties especially influence resources that are not commonly accessible to the lower echelons in an organization. Teams that have vertical cross-hierarchy ties may be expected to have access to information and other resources that provide them with a broader perspective than those who do not have such cross-hierarchy ties (Cross and Cummings 2004).

Cross-hierarchy ties allow a team to gain a perspective of how the team output fits in the overall firms' objectives and goals. Access to higher hierarchical levels helps teams to take stock of what is relevant from a technical or commercial point of view within the rest of the project or organization so team activities can be aligned to this (Hansen *et al.* 2001; Nahapiet and Ghoshal 1998; Subramaniam and Youndt 2005; Mom *et al.* 2009). Teams without such a view may tend to focus on their isolated part of the overall design task, neglecting the bigger picture (Schönrok 2010).

Teams that utilize cross-hierarchy ties also gain access to support and influence resources (Ancona and Caldwell 1992a; Blindenbach-Driessen and Van den Ende 2010). The higher hierarchical echelons in the organization provide legitimacy to information obtained to either a person or an idea, helping teams to put their plans

into action (Brass 1984; Cross, Rice and Parker 2001; Feldman and March 1981). Access to influencers can help in bringing new ideas developed by the innovation team to the positive attention of management, it can generate positive publicity, and it can even hamper or stop competing projects (Bonner *et al.* 2002; Kijkuit and Van den Ende 2007).

Cross-hierarchy ties can help the team resist efforts by management to impose inappropriate agendas and prevent extensive debate over aspects of and constraints for their projects (Haas 2010). As organizational politics may not be the strong suit of innovation professionals, having a champion can positively affect the team's performance (Markham 1998; Kelley and Lee 2010; Weissenberger-Eibl and Teufel 2011). Cross-hierarchy ties thus provide innovative teams with management-related resources that assist them in performing their tasks.

Although some previous research has looked into categorizing boundary spanning activities (Ancona and Caldwell 1992a; 1990), no strict conceptual distinction has been made between horizontal and vertical boundary spanning activity. We suggest that horizontal and vertical cross-ties each provide the team with distinct resources that can enhance a team's innovative performance in distinct yet complementary ways.

Hence, we submit the following proposition:

> ***Proposition 1:*** *Both number of horizontal cross-unit ties and number of vertical cross-hierarchy ties maintained by an innovation project team will be positively associated with innovative team performance, since:*
> – *horizontal cross-ties mainly provide access to diverse and task-related information and knowledge, and*
> – *vertical cross-ties mainly provide managerial influence and organization-related information.*

Concentration of ties

Proposition 1 differentiates between horizontal and vertical cross-ties and submits that the availability of these ties to the project team benefit innovative performance. Yet it goes without saying that the number of ties maintained, horizontally or vertically, cannot expand indefinitely. Employees with a large number of established relations are known to strongly rely on these and are known to ignore

opportunities for initiating relationships with new partners (Gulati 1995; Tsai 2000, 2001). This behavior is due in with the costs involved in establishing and maintaining relationships (Tsai 2000), and may be expected to apply to the team level as well. Time spent searching for and transferring knowledge from sources outside one's established network takes time away from working on one's functional tasks (see Haas and Hansen 2005). In line with Haas and Hansen (2005) we expect that incurring such search and transfer costs is worthwhile if there is substantial learning, resources or political support to be gained, but when benefits are marginal or negligible due to redundancy in ties, actors are likely to channel their time to more economically profitable activities. For teams to utilize both types of ties effectively, we therefore suggest that cross-ties should *not* be scattered across the team, with most of the team members being involved in maintaining external relations. Rather, external ties are preferably maintained by a limited number of team members only. Allen (1977) was among the first to stress how specialization at the innovative team level enhances the flow of knowledge and thus stimulates scientific and technological developments. The boundary spanner, receiving only modest attention in the literature in recent years, is a key actor in the innovation process. Boundary spanners acquire, translate, and disseminate external resources throughout the organization (Whelan *et al.* 2011).

As indicated by Marrone *et al.* (2007, p.1423), individuals who carry out boundary spanning responsibilities gain status and influence through access to unique knowledge, but also experience significant role overload as a result of facing simultaneous and often conflicting pressures (Kahn *et al.* 1964; Katz and Kahn 1978). A divide between internal versus external orientation of team members seems to exist in many cases, with the majority of team members under-engaging in externally oriented activities and focusing instead on their teams' internal activities (Ancona 1990; Marrone *et al.* 2007).

In line with Ancona and Caldwell (1992a) we also expect this distribution to differentiate between horizontally-oriented boundary spanning and vertically-oriented boundary spanning. In line with the idea of specialization, we expect the effectiveness of the team to increase particularly when only a small number of people mediate between the project team and the upper hierarchical echelons. The brokers are capable of establishing themselves as preferred points of contact towards the upper echelons. Since horizontal contacts are likely to occur more by functional specialization and expertise of team members, horizontal ties may be more dispersed

throughout a team. Division of tasks in the team enables some team members to (partly) specialize in developing either horizontal or vertical cross-ties, while others can freely focus on team-internal activities to complete project deliverables. People in the team thus develop expertise in various areas, some mainly technical, others mainly relational (or political). Division of cognitive labor reduces the amount of information for which each individual is responsible, yet provides all members with access to a large pool of information and influence across multiple knowledge domains (Hollingshead 2000, p.258).

Although earlier studies commonly leave out this distribution of boundary spanning activity among team members, we believe that a balanced distribution is important for a project team to function effectively. This results in the following proposition:

> ***Proposition 2:*** *Innovation project teams whose horizontal cross-unit and vertical cross-hierarchy ties are maintained by a small number of team members, perform better than project teams that have scattered these ties across many project members.*

Previous research has generally assumed that vertical cross-ties are maintained by one individual only. Our discussion does not assume this a priori. Nevertheless, the number of vertical cross-ties for successful innovative teams are likely to be more concentrated than their horizontal cross-ties.

3.3 Setting, data, methods and analysis

This study analyses five innovation project teams at Beta Company, one of Europe's largest and most innovative payment processors. Beta Company orchestrates and processes billions of transactions annually for financial institutions and commercial entities from across the globe. Our case study is of an illustrative nature since the existing knowledge base is still underdeveloped (Yin 1994) and the inductive way of data generation is anticipated to provide a greater understanding and a broader description of process and meaning (Doherty and Alexander 2004). Drawing from the interpretive research tradition, we employ qualitative techniques and an illustrative case study design. The adoption of a qualitative approach provides

for a holistic yet focused means of data gathering, analysis, interpretation, and understanding that is particularly suited to research that investigates the "why" and "how" of management decision making in organizations (Gummesson 2000; Silverman 1997). Because the multiple case research methodology is considered to be more robust than a single case study, the potential benefits of data richness, depth, and quality compensate for the associated shortcomings of possibly more limited representativeness and generalizability (Eisenhardt and Graebner 2007; Ibeh *et al.* 2006; Yin 1994).

The study aims to analyze the performance of innovative project teams in terms of their cross-horizontal and cross-hierarchy ties. We do this by combining quantitative data on the cross-ties maintained by five teams with qualitative interview and observation data. The qualitative analysis of data followed an inductive process and observed the recommendations of both Morse (1994) and Lindlof (1995).

Beta Company

As a leading European payment processor, Beta Company depends on reliable technology and processes, and supports this with investments in product and service innovation. Beta Company is organized according to a unit structure, following a functional segmentation, with much autonomy for the separate units. The company expands its reach within Europe under recent SEPA (Single European Payments Area) objectives. The firm's five innovative projects studied concentrate on the improvement of financial processes and technologies.

Data collection at Beta Company was conducted in the Spring and Summer of 2010. Beta Company maintained five innovation project teams – each of which was included in our analysis and were identified by corporate management to be expected to be able to contribute to the future competitive advantage of Beta Company. Each of the teams operated under the responsibility of the innovation unit. All projects were considered equally important by management, and could claim similar resources. Data collection for this study was sponsored by the director of the innovation unit. The five projects were organized in a similarly autonomous manner, with delegated control and discretion over tasks and decision making (Amabile *et al.* 1996; Goodman *et al.* 1988).

Data collection

Data were collected using two separate methods: a network questionnaire among the full population of employees involved in innovation at Beta Company and semi-structured interviews with managers as well as project team members. In accordance with the specific aims of this research, we apply Social Network Analysis (SNA) methodology in an organizational setting. SNA methodology deals with the study of the relationships between a definitive number of entities (in this case: teams of individuals) and allows for the analysis of the relationships established between these entities (Molina 2001).

Since the boundaries of the innovation population are unclear at the start of the study, we take an egocentric approach to our data collection and apply snowball sampling procedure to collect the network data required (Wasserman and Faust 1994). The interviews conducted allowed the researchers to become familiar with the organizational setting to design the network questionnaire, and, secondly, to serve as the first round in our snowball sampling procedure. Our target population is the entire set of individuals with whom the innovative project teams maintain interaction, stretching across team boundaries and reaching most units in the firm. Snowball sampling involves several rounds of surveying where information gathered in each round helps to determine who should be approached in a subsequent round until no more new names are mentioned.

Questionnaire

The online questionnaire contained questions identifying individual relations and perceived project performance (Marsden 2002). Every questionnaire was accompanied by a personalized cover email, signed by the director of the innovation unit to stimulate the rate of response. Respondents who did not reply initially, were approached to fill out the questionnaire in a personal interview. Information from the 30 employees of the innovation unit involved in at least one innovation projects led to a further 54 individuals. Surveying these finally resulted in a total network population of 281 individuals. We allowed for new names to be mentioned by respondents in this third wave, but no additional names emerged. The list of individuals surveyed was also validated by Beta Company's general management. To reduce ambiguity regarding the interpretation of the questions by the respondents,

the network questions were formulated in the native language. The overall response rate was 93 percent.

Interviews

Semi-structured interviews were conducted with each of the innovation unit members as well as a selection of team members and management from other units that were identified as part of the innovation network. This provided contextual input in addition to the network data collected via the online questionnaire. Interviews typically lasted one hour, were recorded, transcribed and coded. In addition to the scheduled interviews, we conducted a large number of ad-hoc interviews with people engaged in the projects, as well as study agendas, minutes, project plans, and other written material relating to the projects to avoid bias.

Item
– Quality of work done
– (Internal) customer service provided
– Productivity
– Completing work on time
– Completing work within budget
– Providing innovative products and services
– Responding quickly to problems or opportunities
– Initiative of the team
– Cooperation with non-team members
– Overall performance

Table 3.1: Team performance items

Team performance

Each of the projects was scored by the Management Team on nine items on a 7-point Likert scale (see Table 3.1; Campion *et al.* 1996; Smith-Doerr *et al.* 2004; Ancona and Caldwell 1992a). As noted by others, in organizations the vast majority of performance ratings come directly from the immediate supervisor (Bretz *et al.* 1992, p.331; Scullen *et al.* 2000) and are valid reflections of individual or team performance

(Arvey and Murphy 1998, p.163). In line with Mehra *et al.* (2001) performance ratings were used only for research purposes and treated confidentially (Wherry and Bartlett 1982). The team performance classification procedure resulted in three projects qualified as performing and two projects qualified as under-performing. In addition, members of the Management Team were invited to comment upon the evaluation scores and found these to be consistent with their overall assessment (Balkundi *et al.* 2007). Cronbach's alpha of the performance construct is 0.84.

Variables

Network ties of each team member were measured by asking with whom they discussed new ideas, innovations and improvements regarding products and services relevant to their projects (Rodan 2010: Borgatti and Cross 2003; Cross and Prusak 2002; Rogers and Kincaid 1981; Stephenson and Krebs 1993). Based on the network data thus generated, the number of horizontal cross-unit ties and vertical cross-hierarchy ties were calculated. *Horizontal cross-unit ties* refers to the number of ties outside the unit that a team member is affiliated with, but inside the boundaries of the organization. Following Cross and Cummings (2004), *vertical cross-ties* was defined as ties to individuals higher in the hierarchy. We aggregated to the team level by calculating the total count and variation of the number of horizontal and vertical cross-ties of each project team.

Beta Company has 8 hierarchical levels present in its formal organization structure. For robustness purposes we analyzed vertical cross-ties in two ways. We operationalized vertical cross-ties as those ties maintained by team members that skipped at least 2 hierarchical levels upward in the 8 tier structure. In our second approach we combined the top two hierarchical levels (i.e. the ties to the company's top management, 22 employees) and operationalized vertical cross-ties as those ties that reached directly to this highest managerial echelon.

To analyze our data to determine the validity of proposition 2, we calculated the proportion of members of each team that together hold 50% of the team's horizontal or vertical cross-ties. This common concentration measure reflects the extent to which these ties are concentrated among only few team members.

Data analysis

For each individual actor project membership and unit affiliation was identified. Subsequently a count and average on the number of horizontal and vertical cross-ties per project team was calculated.

We conducted content analysis by searching for recurring words, themes, or core meanings in interview transcripts, allowing for the emergence of important themes and patterns in the data (Patton 2002; Strauss and Corbin 1998). Qualitative data collected during interviews and through the online questionnaire was independently coded; ratings were discussed when necessary. Relevant yet difficult to classify quotations were clarified by re-interviewing the individual who was the source of the quote. The transcripts of interviews and the questionnaire output were analyzed for the presence of positive, neutral or negative expressions by team members and management about team structure and team performance. As an additional check on the interpretation of the content, we deployed peer and managerial examination. Colleagues as well as general management were asked to comment on our interpretations. The procedure resulted in characteristic quotes by team members and management that were classified and coded by project type in tables 3.4a, 3.4b and 3.4d.

To avoid bias as a result of only submitting a questionnaire to or interviewing those who are willing to speak up, we monitored interactions of all project teams by means of observation on the work floor, studying agenda topics and minutes of meetings and other written material. During this process we were especially inquisitive for any input that might suggest falsification of our propositions.

3.4 Results

In presenting the findings for the five project teams studied, we codified according to alphabetical letters (A, B, C, D and E) to preserve confidentiality. Project descriptions (appendix I) are necessarily brief for this reason as well. Key descriptive statistics by project are presented in Table 3.2. In addition, representative quotes relevant for the focus adopted in this chapter are used as the basis of the analysis (cf. Hutchinson *et al.* 2007).

Figure 3.1 presents the full network of individuals involved in innovation, who are either part of a project team or involved in other organizational units. Node

shape indicates business unit membership. Figure 3.2 present the network structures for the five projects.

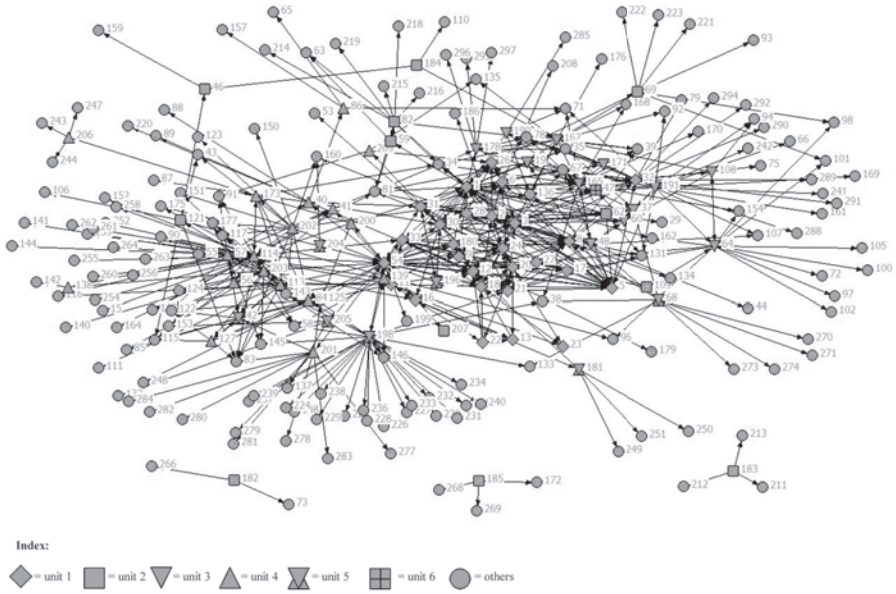

Figure 3.1: The innovation networks at Beta Company (n=281)

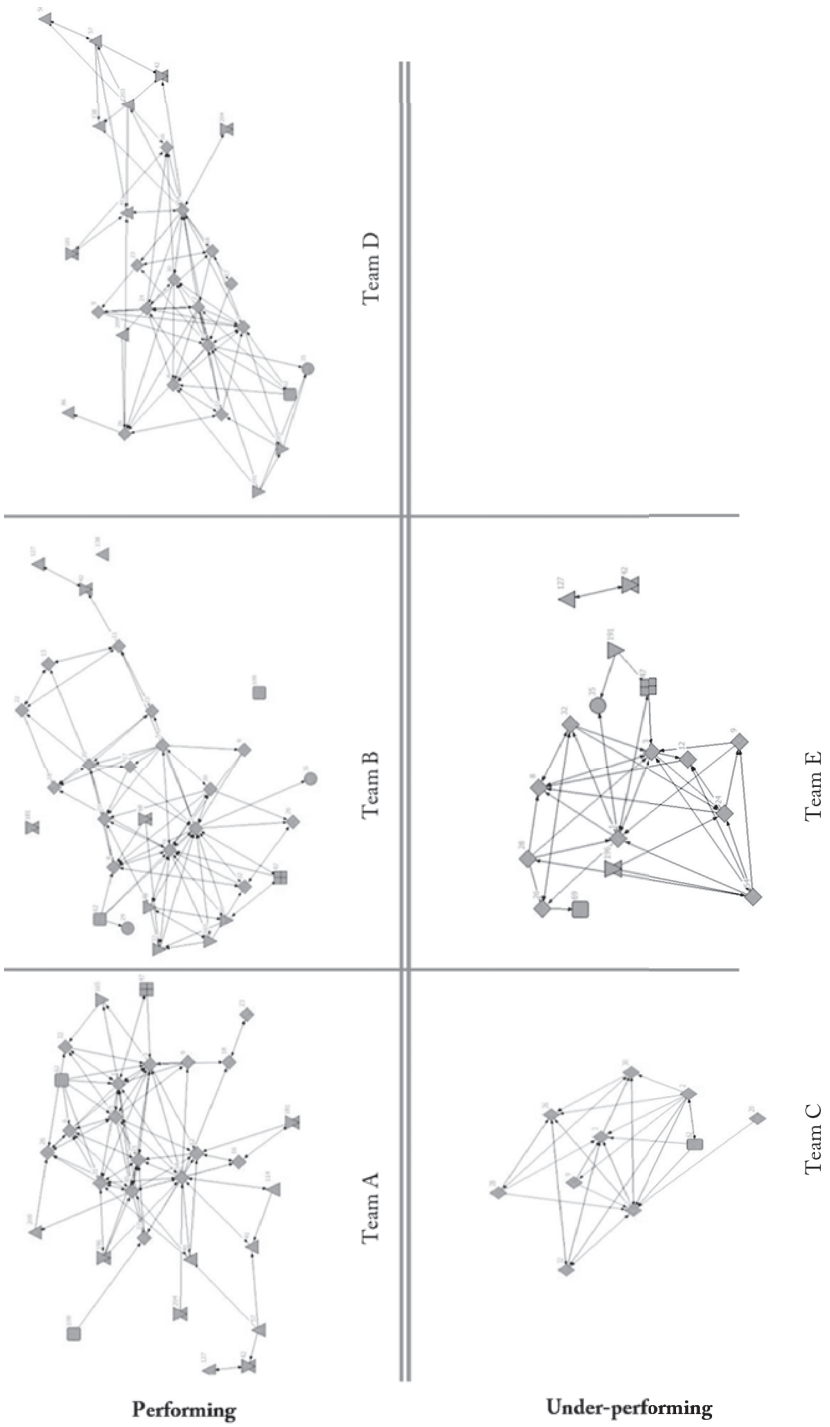

Figure 3.2: Innovation networks among innovative team members per team (performing and under-performing)

Horizontal cross-ties

All members of the organization were remarkably well capable of identifying the project teams that were successful and related that to the teams' ability of incorporating the insights of peers that were no official team members (i.e. horizontal cross-ties). The under-performing teams were commonly perceived as much less connected horizontally. Table 3.2 shows the number of ties maintained by each team and table 3.3 shows the extent to which the two types of cross-ties are distributed among performing versus underperforming teams. This quantitative information indicates that successful innovation project teams tend to have more horizontal cross-ties than under-performing teams (127.00 and 67.50 respectively).

Network descriptives:	Overall network	Team A	Team B	Team C	Team D	Team E
# of individuals	281	30	30	10	28	17
# of unique ties	841	258	183	123	304	294
Performance		Performing	Performing	Under-performing	Performing	Under-performing

Table 3.2: Descriptives: innovation networks Beta Company

Cross-ties	Project type	Mean number of cross-ties per team
Horizontal cross-ties	performing	127.0
	under-performing	67.5
Vertical cross-ties (skipping two levels)	performing	43.0
	under-performing	29.0
Vertical cross-ties (directly to top echelons)	performing	19.3
	under-performing	13.0

Table 3.3: Performing and under-performing innovative teams compared

Qualitative information shows a clear tendency for team members of both performing and under-performing teams for including colleagues from outside of the team in their innovative activities. Recurring themes brought up by the interviewees related to diversity of insights, specialized expertise, back-up in case of unforeseen events such as illness or job transfer by team members and sustainability of the final

project deliverable in the organization. All interviewed project leaders and project members raised the topic of horizontal knowledge themselves, indicating the salience of such ties to them. Interviewees in the performing projects linked having sufficient horizontal ties to situations where they were allowed to think and act outside of the boundaries of their individual task – they indicated that this greatly benefited the performance of the team. Members of unsuccessful project teams were also aware of the relevance of horizontal cross-ties, but were unable to organize these effectively.

Performing teams: A, B, D	**Under-performing teams:** C, E
– In my opinion this project is particularly successful due to the broad and multidisciplinary approach and the clarity of objectives. – Much of our expertise lies in knowing who is doing what inside the firm. When we need it, we can get it. – Historically we actually have quite some contacts on our own when it comes to other fields of specialty relevant to our project. I became more aware to utilize mine to our advantage. – Involvement was created with other specialist within the company which has led to improvements in the conceptual design. – Our expertise is appreciated throughout the organization and we can use this to our advantage when looking for input ourselves – By means of my forma land informal contacts I believe to have a rather good understanding of what goes on within the organization and whom to approach to get things done for my project. – There is certainly sufficient sharing of ideas, for instance at the coffee corner and in team and unit meetings. – Good atmosphere, and people <other units> know what we are doing. – Our project team is performing according to plan. No issues with getting others on-board and as such it is relatively easy to secure the latest insight from throughout the organization and put them to good use This team was established as an example of cross-unit staffing, and it seems to work out quite well indeed.	– Everyone is aware of the benefits of scouting new ideas and getting others involved, yet ideas and talents are being wasted. We lack effective distribution of our ideas to colleagues outside of the team or innovation unit. – Some play their relations quite close to the chest. If they do so, I might as well do so. – There is insufficient between-teams talk about innovation. – Aligning between units and the team should improve. – Things look poor; nothing seems to get done and nothing is accomplished for production to take up. It appears that no one in the rest of the organization is considering cooperation with us.

Table 3.4a: Selected representative comments regarding horizontal cross-ties

The director of the innovation unit overseeing the innovative projects remarks about the under-performing teams that these: *"are far too much internally focused, trying to get it right by themselves, and they fail to get others involved… Clear coordination is also lacking."* The director adds that one of the under-performing projects displays a team structure that is *"getting stuck in attempts to distribute ideas within the team. These efforts seem to be largely failing, however, and opportunities identified by some team members are not considered, let alone exploited by the project team to really get things going. This demotivates team members and leaves only a handful of individual to get the project going."* Table 3.4a provides typical additional comments made by team members regarding horizontal cross-ties.

Vertical cross-ties

Performing innovative teams have considerably more cross-hierarchical ties than under-performing teams. In line with proposition 1, the number of vertical cross-ties that skip at least two hierarchical levels is substantially higher for the better performing teams (43.0) than for under-performing teams (29.0). The number of ties directly to senior management, the highest echelon of the organization, on average, is substantially higher for performing teams than for under-performing ones (19.3 versus 13.0).

Interviews with management provide further insight: management clearly recognized that the most successful project teams were well connected to upper management and had secured a champion and other political support. Interviews with management indicate that teams with limited vertical ties were more vulnerable to being terminated in the early project stages. Content analysis of interview transcriptions identified management commitment and access to the information and influence that management provides as the principal resources that result from vertical cross-ties. Reflection by the management team members on a decade of experience with innovation projects further indicated that the innovative output of teams that had sufficient vertical cross-ties was more likely to be successfully implemented in the organization's operating core.

The following observation by a team member of one of the successful teams summarizes the overall sentiment effectively: *"Being able to utilize the established relationships with higher echelon management by a number of team members has helped [the team] to secure critical resources to prove our value to the company."* A colleague

from one of the other 'performing teams' added that *"Management is clearly involved with our business. I believe <our project team manager> has helped in getting them there and getting us involved too. I have seen that differently at other projects."* A selection of quotes in Table 3.4b gives further indication.

Performing Innovative Teams: A, B, D	**Under-performing Innovative Teams:** C, E
– Over the last period (period monitored) awareness has been raised within the organization regarding added value to the business. It sometimes feels like our own dragons den.	– Why can we not connect to the right sponsors?
– Access to the higher management echelons and corresponding managerial commitment has paid off well for us.	– It seems as if management is not committed to us; gaining access to higher management seems not realistic.
– Management is clearly involved with our business. I believe our project team manager has helped in getting them there and getting us involved too. I have seen that differently at other projects.	– This project might be stopped next year, if things continue as they go at the moment. I might as well bail out now, as management does not seem to notice what we do too much anyways.
– The number of stripes does matter in our organization. We have only a few of us who can really make these stripes work to our advantage. Our project team manager is one of those people.	– Things go slow and new service development happens in inner-circles. Decisions are politicized rather than based on arguments and company interests. We are not involved.
– Particularly now the project is becoming more visible to higher management, the sense of urgency stimulates people to follow on and share their knowledge.	– Setting our own directions seems to be counter-productive as it drains energy from the team and results in a lot of debate on who should be doing what.
– Being able to utilize the established relationships with higher echelon management by a number of them, has helped out team to secure critical resources to prove their value to the company.	– The project is in a pilot phase with low support within the organization and low resources to increase this support.
	– There seems to be much going on elsewhere in Beta Company that we don't know about. We need proper sponsorship.
	– Since we have no common goals and leadership, all seems to face much resistance.
	– There is little communication between higher management and the rest of the company.

Table 3.4b: Selected representative comments, regarding vertical cross-ties

The differentiated benefits of cross-ties

Besides highlighting the effects of cross-ties per se, Tables 3.4a and 3.4b also suggest that the horizontal and vertical cross-ties provide teams with **distinct** benefits. Both the questionnaire and the interview transcripts reveal that horizontal cross-ties mainly provide diversity of knowledge and ideas to the teams. In the interviews, team members expressed that horizontal contacts raised their awareness to alternative insights and new ideas that were valuable to team objectives. Members

of the performing teams asserted that horizontal cross-ties had stimulated them to think creatively and explore new avenues to finding (technical) solutions and had provided them with creative stimulus that was clearly different from their regular, more routinized, intra-team approach to their development task. The unsuccessful teams were aware of the relevance of horizontal cross-ties, but were unable to organize these effectively, and expressed that this had especially hurt their solution-finding success.

Vertical cross-ties, on the other hand, were reported by team members to principally provide their teams with access to managerial influence and organization-related information. As Table 3.4b shows, the benefits of sponsorship, managerial awareness, and a sense of relevance and direction were mentioned by members of the successful teams and by overall management. Our observations show that the under-performing teams were not capable of securing these benefits even though they were keenly aware of the advantages of access to influence resources. Hence they displayed frustration at their own team failing to attract these particular resources.

In summary, we found strong support for proposition 1: horizontal cross-unit and vertical cross-hierarchy ties both support innovation teams to be more successful. These ties do so by providing distinct resources: horizontal cross-ties mainly provide access to knowledge and information that is substantively tied to the team's task, whereas vertical cross-ties provide the team with managerial support and information that promotes the team´s chances of survival.

Concentrated horizontal and vertical cross-ties

As a measure of concentration we calculated the proportion of team members that together maintain at least half of the overall horizontal or vertical cross-ties per team (see Table 3.4c).

Type of cross-tie:	Team A	Team B	Team C	Team D	Team E
Horizontal cross-ties	0.20	0.16	0.40	0.14	0.23
Vertical cross-ties	0.13	0.10	0.20	0.10	0.18
Performance	**Performing**	**Performing**	**Under-performing**	**Performing**	**Under-performing**

Table 3.4c: Proportions of team members with at least 50 percent of the team's horizontal/ vertical cross-ties*

** Calculated by considering the team members with the highest numbers of cross-ties in each team first.*

For the successful teams, few team members tended to maintain at least half of the team's horizontal cross-ties (Table 3.4c: 0.14, 0.16 and 0.20 respectively). For the two under-performing teams these proportions are 0.23 and 0.40, indicating that horizontal cross-ties are less concentrated in the under-performing than in the performing teams. For the performing teams, their larger number of horizontal cross-ties tended to be maintained by a smaller proportion of the team's members, compared to the under-performing teams.

Vertical cross-ties show a similar effect. For performing teams, half of the vertical cross-ties were maintained by less than 13 percent of the team members (proportions of 0.10, 0.10, and 0.13), with under-performing teams needing 18 and 20 percent of their team members for that. All teams in our sample have concentrated their vertical ties more strongly than their horizontal ties. When the majority of cross-ties is maintained by only a few team members this frees the larger part of the team from having to deal with the maintenance of ties outside of the team. Maintaining such ties tends to be costly, and may prevent team members from focusing on ongoing work.

The interviewees also brought up that performing teams concentrate both their horizontal and vertical ties among a small number of team members. Specialization regarding relationship management with the higher echelons is repeatedly related to a better functioning team. It was not thought of as being merely a task for the assigned project manager per se. Observations show that team members of the performing teams had clear views and expectations about each team member and their strengths and weaknesses, including in regards to management activities. Team members of the performing teams clearly articulated the benefits of this division of labor to enhance performance, utilizing skills of each individual effectively, and to keep team morale high. Team members who proactively developed and maintained horizontal or vertical cross-ties were perceived positively by colleagues and senior management, who referred to them as 'entrepreneurs,' 'experts' or 'organizational runner-ups'. Management, in turn, appreciated only having to maintain contact with a limited number of representatives from a team, rather than being approached by a larger group. Also here this task was not framed as the responsibility of the assigned project manager. The under-performing teams, in comparison, were much less clear about role distribution. To team members this was an important reason for low morale and conflict in the teams. Team members indicated that effective team coordination

was lacking. Interviews with management underscored these observations. When members of the unsuccessful teams tried to compensate for the lack of horizontal and vertical coordination, the number of individuals involved in horizontal cross-ties and especially vertical cross-ties increased, along with frustration among team members and management. Table 3.4d presents representative commentaries.

Reflections on the project portfolio over the past eight years by senior management particularly pointed towards the relevance of concentrated vertical cross-ties as a means to enhance team performance. Vertical connectedness and dedication by a restricted number of members of a team (not necessarily the project manager only) was viewed as key to effective transition of the team's work to the organization at large. Exemplary is a comment by a team member of an underperforming team who noted that *"My teammates and I do not have clear responsibilities. As a result delivery is running behind schedule and the project shows insufficient innovative potential."*

Performing Innovative teams: A, B, D	**Under-performing Innovative teams:** C, E
– Responsibilities are clearly defined. Some are better at talking to management, others are plain specialist who get us noticed in another manner –and make sure we are recognized by others (specialists). Both make us successful as a team. – It is vital to know how to use my contacts and tenure to get ahead of the pack and to secure capacity for our pilots (proof of concepts). <…> My colleagues know that and respect this as it helps us to move forwards.	– No one is clearly accountable for specific tasks with regard to external alignment to other parts of the organization or even towards clients. – People in this project do not have clear responsibilities. Project shows insufficient innovative potential. – Things could go much further; there is so much procedure and red-tape. – Since people are too much involved with all kinds of things, there is a lack of focus. – It is unclear who does what; responsibilities and results are not that clear. – Activities are not coordinated and disconnected; there is no contact between projects on innovation. – Developing a new service takes a lot of time for project C practitioners. – Nobody in this team takes charge or seems to look at the bigger picture; everybody is taking care of their own immediate interests only.

Table 3.4d: Selected representative comments regarding the concentration of horizontal and vertical cross-ties

In each of the performing teams horizontal cross-ties were maintained by others than vertical cross-ties. This indicates that different traits and capabilities are required for horizontal as compared to vertical cross-ties. We thus find both quantitative and qualitative indication that teams that have concentrated horizontal, but especially vertical cross-ties among a small number of team members outperform teams that have scattered these ties across project members. These findings support proposition 2.

3.5 Discussion and conclusion

The objective of this study was to investigate the contribution of horizontal and vertical cross-ties to a team's innovative performance. Our findings, based on qualitative and quantitative data, indicate that both types of ties help teams to be innovative, and that may be the case in particular for vertical cross-ties. Our findings thus show that conceptually separating horizontal from vertical cross-ties is important. The first foster diversity, while the latter foster organizational support and managerial sponsorship.

Project teams that perform well have more cross-ties in general and vertical cross-ties in particular. However, these cross-ties should be concentrated in the hands of a few team members (cf. Hansen 2002) and be a specialized job for some team members.

While literature (Hansen 2002) assumes that team members can and do access horizontal and vertical cross-ties when needed, our findings suggest that this may not actually happen. Only for the successful project teams did this process seem to function both effectively and efficiently: ties were maintained by a small group of team members. These teams were able to create and sustain a large number of both horizontal and vertical cross-ties. To unsuccessful teams an important reason for lagging performance was clear, yet, unlike what Ancona and Caldwell (1992b) imply, the teams were unable to implement a proper strategy to remedy this. As members of the unsuccessful teams tried to compensate for the lack of available knowledge and managerial support, many team members ended up having to maintain cross-ties – hardly a task R&D specialists cherish – frustrating both team members and management.

Our findings thus underscore the outcome of the experimental finding suggested by Cross and Borgatti (2004, p.152) that there is more to an innovation team being successful than just a general awareness about who has relevant knowledge in the organization. In addition to access to a diverse set of others through horizontal cross-ties, vertical cross-ties ensure management attention and legitimacy which may help provide resources in time.

Managerial implications

Proper formation of project teams increases the probability of achieving successful innovation outcomes. Our findings are particularly relevant to team formation and to ensuring successful functioning of innovative project teams, especially in terms of assigning clear team roles. Horizontal and vertical cross-ties serve different purposes. Taking care of vertical cross-ties in particular is important, and may be assigned to an appropriate individual, but can and perhaps should be maintained by multiple, but few, team members. These vertical cross-ties are crucial to secure project buy-in and legitimacy and to gain managerial attention and securing resources. When management finds that it needs to converse with a fairly large set of members of a team, this does not provide a good signal regarding the functioning of the innovation project team.

Limitations and future research

This study has a number of limitations. The organization we studied is a large multinational resembling many large firms. However, there may be industry-specific or firm-specific aspects to the effect of cross-ties on the functioning of the innovation teams. The extent to which our findings are generalizable is unknown, and we emphasize the exploratory nature of this study. Social network data is very difficult to collect, for instance because high response rates are imperative. Even though the number of cases was five, we collected (network) data on 281 individuals. Extending the number of project teams in a study to a sample size worthy of a thorough quantitative analysis, especially when comparing different industries, therefore is an exceedingly laborious and complex task (e.g., Schönrok 2010; Kratzer *et al.* 2010).

A second limitation relates to the partly qualitative approach chosen for this study. Although an extensive and rigorous process to collect and interpret the

qualitative data has been followed, our interpretation can potentially be biased. To counter this possible effect we explicitly cross-referenced with established formal team performance procedures within Beta Company and with other sources of data, also allowing for multiple methods to be used. In addition, we especially sought evidence against our propositions. However, the evidence turned out overwhelmingly in concert with the propositions.

Finally, we study the effects of the number and concentration of cross-ties that contribute to a team's innovativeness. It may be that the importance of cross-ties varies over the span of an innovation project. Analyzing performance information for subsequent phases of projects, including the post market-launch phase, would enhance our understanding of the contribution of horizontal and vertical cross-ties to team innovativeness. Analyzing such longitudinal data (including repeated measurements of the networks) could also help determine to what extent and under what conditions an abundance of one type of cross-tie can compensate for the lack of another.

Appendix I: Project descriptions

Project A

Project team A develops a new product aimed at entrance into a new, high-risk-high-yield market. Team members have adopted an entrepreneurial spirit and view their project as an entrepreneurial venture and, moreover, are aware of the relevance of buy-in to their project by the rest of the organization. To this end, they have established several new formal and informal connections to other stakeholders within the organization and know their way around their established contacts where relevant to the team. The team considers deep knowledge of the market and product developed as an asset in creating and enhancing commitment by colleagues who are not directly involved in the project. The team leader is an experienced project manager, who is seen as 'in the loop of things' by his team subordinates, both formally and informally. In addition, team members emphasize the multidisciplinary team staffing as well as clear goals and scope as most important for their personal effectiveness and project success.

Project B

Project team B is developing a rather futuristic business channel – boosting customer intimacy as well as operational efficiency. Team members seem well aware of each other's tasks and responsibilities, although the exact project scoping is still less clear. With several technical specialists closely cooperating with highly connected managerial colleagues the team seems well connected within the organization. Given some major technical challenges in the project's scope, team members have already started calling upon their personal relations to make sure all expertise available is put to use. The futuristic nature of the project deliverable has created awareness about securing managerial involvement, a task that is trusted to two of the more tenured team members that are known to be connected well. Team morale seems to be high and so are internal team expectations of each other and of the final project result.

Project C

Project team C can be typified as a project team in turmoil. Although already 'on the road' for a while, team members criticize the unclear scope and insufficient information being shared within the team. Interaction with other parties within, but also outside the organization is described as rather poor. Team members as well as the team leader point out that corporate management does not seem to be much involved, and several team members believe that the project as under-prioritized by management. Management does not concur. Several attempts to increase involvement of others have failed for a variety of reasons, which has resulted in an internal focus by the majority of the team members. Although relevance of the project and its innovative contribution (generating a new product channel) are still seen as evident, morale seems to be rather low.

Project D

Project D anticipates one of the major trends as identified in the market. The project has been greeted with great enthusiasm by team members as well as band corporate management, and the team seems to have secured an effective way of raising awareness among peers and keeping people involved. Although the project team is the smallest of the teams that are classified as successful, it seems to have managed an effective division of labor. Still, the team believes more is to be made of the team potential, and relationships with key stakeholders within the company are revisited to assure fit of the team with company objectives. The team's communication network is seen by team member as one of its important strategic assets.

Project E

Project E addresses a market opportunity derived from recent developments in a market related to the current market for Beta, seeking to apply core competencies in a novel way. It has confronted some major hurdles. Several of these hurdles related, according to team members, to the way in which the team has been able to tap into corporate resources and managerial commitment. The team felt hard-pressed to stay on top of things. Each team member seems to be involved in deciding on the team's direction, but insights vary strongly and so decisiveness at team level is lacking.

Part II

Individual Network Antecedents and Intra-Organizational Innovation

Chapter 4

Individual Connectedness in Innovation Networks: on the Role of Individual Motivation[7]

4.1 Introduction

As firms find themselves in increasingly competitive markets and realize that they must be more innovative (Grant 1996), the importance of knowledge transfer within their company is increasingly recognized. Knowledge may be spread throughout the organization and not be available where it might best be put to use. Transfer of knowledge within the organization to gain competitive advantage has thus received considerable attention in the literature (Grant 1996; Teece *et al.* 1997: Moorman and Miner 1998; Hansen 1999). Scholars have emphasized that effective transfer of knowledge between employees within an organization indeed increases the creativity and innovativeness of that same organization (Tushman 1977; Ghoshal and Bartlett 1988; Amabile *et al.* 1996; Moorman and Miner 1998; Kanter 1983; Hargadon 1998; Perry-Smith and Shalley 2003). It is often claimed that HRM policy, if properly conceived, can help stimulate such knowledge transfer. Effectively orchestrating knowledge transfer to stimulate innovative outcomes requires further attention, however (Jackson *et al.* 2006).

[7] This chapter is currently under the 3rd round of review at *Research Policy* as Aalbers, H.L., Dolfsma W.A. and Koppius, O. (2012). "Individual Positioning in Innovation Networks: on the Role of Individual Motivation". A previous version of this chapter was presented at the 2011 DRUID conference, Copenhagen, Denmark, and included in the conference proceedings as Aalbers, H.L. and Dolfsma, W.A. (2011). "Individual Positioning in Innovation Networks: on the Role of Individual Motivation".

As pointed out by Foss (2007) organizations can seek to influence individual actions to help accomplish favorable outcomes to the organization as a whole. Such orchestration may start with an understanding of both what the individual motives to transfer knowledge are, as well as, structurally, with whom individuals exchange knowledge. The latter is determined by an individual's position in the knowledge transfer network of an organization. The relationship between network structure and individual motivation has been receiving some but not much attention over the last decade (Kadushin 2002; Kalish and Robins 2006). The number of different issues addressed in this new literature remains rather limited and data at the level of individuals in a firm is indeed difficult to gather and thus, perhaps, rare. Studies have only started to explore the effect of individual psychological differences on network structures (Klein *et al.* 2004). The question as to how individual differences predispose actors to position themselves in a network of relations still has not received a persuasive answer as a result. As Mehra *et al.* (2001) note, social network researchers seldom discuss the effects of individual psychological differences on network structure and particularly not in the context of knowledge transfer. Likewise, HRM researchers seem only sporadically to apply social network theory in their studies (with the notable exception of Minbaeva *et al.* 2003; Kaše *et al.* 2009). Although personality characteristics have occasionally been linked to network position (a.o. Burt *et al.* 1998; Kalish and Robins 2006; Klein *et al.* 2004; Oh and Kilduff 2008; Burt *et al.* 2000), motivation has not been investigated (with Foss *et al.* 2009 as a notable exception). Motivation, however, has been linked to knowledge sharing (a.o. Wasko and Faraj 2000; Kankanhalli *et al.* 2005; Quigley *et al.* 2007), but these studies ignore the network perspective. This study explicitly investigates the way in which motivation explains an individual's connectedness in a knowledge transfer network.

In this chapter, we use the broadly accepted psychological construct of intrinsic and extrinsic motivation (Osterloh and Frey 2000) to examine whether individuals with certain predispositions are indeed (1) better connected than others in a knowledge transfer network, in terms of closeness centrality, or (2) more engaged in inter-unit knowledge transfer. Individuals that are well connected within an organization, for instance, are conclusively shown to contribute significantly to beneficial outcomes including to innovative knowledge transfer in particular (Nerkar and Paruchuri 2005). Connections may be within the own unit, and yet

knowledge transferred from other units, crossing unit boundaries, is believed to contribute to innovation in an important way as well. We thus also determine how motivation relates to inter-unit knowledge transfer. By relating network structure elements to motivational variables, this chapter thus contributes significantly to the understanding of knowledge transfer within organizations and potentially benefits firm innovation policies aimed at increasing employee participation in knowledge transfer and innovation.

4.2 Knowledge transfer within organization: connectedness and motivation

Finding the person within a multi-unit organization who possesses the knowledge that one is looking for may be difficult (Szulanski 2003; Hansen 1999; Hansen and Haas 2001). The relative autonomy of units within a multi-unit organization structure can create a lack of awareness of each other's activities on an individual and a unit level, limiting knowledge-transfer. Within a unit that specializes in one knowledge field, knowledge may also be of the tacit kind. The advantage of the tacit nature of knowledge is that imitation by competitors is relatively difficult (Nonaka and Takeuchi 1995), but at the same time the tacitness of the knowledge requires a high degree of personal contact to disperse it throughout a company (Teece 1998; Hansen 1999). An individual's capacity to contribute to the innovation processes in a firm then depends not just on his own (absorptive) capacity originating from earlier experiences (Cohen and Levinthal 1990), but also depends on the social, professional and hierarchical relations within the organization. Obviously, when one's capacity is limited or biased, one will not contribute as much. If one, however, is not well-connected one's contribution to the innovation process can be limited as well. There have been a number of recent calls to focus on the specific role of the individual in leveraging knowledge transfer (Felin and Hesterly 2007). While the literature on networks has been very helpful in suggesting the beneficial role of informal interpersonal ties in particular as a basis for knowledge transfer (e.g., Granovetter 1973; Hansen 1999), the *actual* process through which organizational knowledge is transferred remains relatively under-explored in the literature (Schulz 2003; Reagans and McEvily 2003).

In this chapter we focus on the social network characteristics known to particularly stimulate knowledge transfer within an organization (Friedman 1979; Ibarra 1993; Tsai 2002; Nerkar and Paruchuri 2005; Teigland and Wasko 2009; Mäkelä and Brewster 2009), and study how an individual's motivation helps explain how individuals will be thus positioned. More specifically we look at how an individual's motivation (extrinsic or intrinsic) explains their connectedness in a knowledge transfer network and affects the maintenance of her inter-unit ties. One's individual network potential to be connected with the rest of the organization or to tap into diverse knowledge from other units may be an artifact of the overall number of ties an individual maintains, which in turn might be constrained for reasons such as the opportunity and maintenance costs of ties. Hence, it is important to note even at this stage, that we include the number of ties as a control in our analysis (cf. Buechel and Buskens 2012).

Individual **motivation** is indicated as the primary trigger for knowledge transfer (Osterloh and Frey 2000; Lin 2007) and as key determinant of successful or appropriate behavior by individuals within organizations in general (Deci and Ryan 1987). Several prior studies explored conceptual (Bartol and Srivastava 2002; Damodaran and Olphert 2000) or qualitative approaches (Weir and Hutchings 2005; Yang 2004) to study the motivators fundamental to knowledge sharing behavior. Motivation is believed to positively influence the amount of knowledge transferred (Gupta and Govindarajan 2000; Tsang 2002), and conversely lack of motivation in accepting knowledge from others leads to 'stickiness' or difficulties in the transfer process (Szulanski 1995). Motivation is central to learning and lack of motivation can hinder knowledge transfer (Perez-Nordfelt 2008).

In line with Osterloh and Frey (2000; Vallerand 2000; Lin 2007) we identify two broad classes of motivation – extrinsic and intrinsic motivation. Extrinsic motivation focuses on the goal-driven reasons, e.g., rewards or benefits earned when performing an activity (Osterloh and Frey 2000). Intrinsic motivation indicates the pleasure and inherent satisfaction derived from a specific activity (Deci 1975). Both forms have been found to influence individual intentions regarding an activity as well as their actual behaviors (Davis *et al.* 1992; Lin 2007). As a result of their predispositions, individuals shape their immediate network environment by establishing, or failing to establish relations (Mäkelä and Brewster 2009; Argote and Ingram 2000).

Sharing[8] knowledge may be extrinsically motivated as the consequence of such behavior is expected to lead to benefits for the employee initiating in this activity (Osterloh and Frey 2000; Kankanhalli *et al.* 2005). In case of extrinsic motivation the sharing of knowledge will continue as long as the expected benefits equal or exceed the cost of participating in the exchange. Consequently when the benefits no longer exceed the costs involved, the exchange will stop (Kelly and Thibaut 1978). Benefits of being involved in knowledge transfer comprise of receiving organizational recognition and rewards or the obligation of other colleagues to reciprocate with knowledge transfer at some moment in the future (Ko *et al.* 2005). Costs typically relate to effort, such as time spent, mental effort, preparation and so on (Lin 2007).

Sundgren *et al.* (2005) observed that information sharing requires self-initiated activities to fully benefit from the available pool of knowledge. Self-initiated activities are influential as they are primarily driven by intrinsic motivation (e.g., Deci and Ryan 2000; Dhawan *et al.* 2002). Engaging in the exchange of knowledge for its own sake, or for the pleasure and satisfaction derived from the experience, is a common indication that one is intrinsically motivated (Deci 1975; Lin 2007). The sharing of knowledge can in itself be fulfilling for employees as it increases their own knowledge level or degree of confidence in their ability to provide knowledge that is useful to the organization (Constant *et al.*1996). Previous research has demonstrated that people actually enjoy helping others by sharing knowledge and experience without an immediate or material benefit for themselves (Baumeister 1982). Such intrinsic motivations have been found to explain human behavior in various contexts (Vallerand 2000; Vallerand and Ratelle 2002).

Research on creativity has found that people will be most creative when they are primarily intrinsically motivated, rather than extrinsically motivated by expected evaluation, surveillance, dictates from superiors, or the promise of rewards (Amabile 1997; Teigland 2009). Knowledge workers have been found to tend to be highly intrinsically motivated and often value knowledge generation for its own sake (Mudambi *et al.* 2007). Furthermore intrinsic motivation is positively associated with creativity (e.g., Amabile *et al.* 1996; Woodman *et al.* 1993). It is reasonable to expect that intrinsic motivation will have the same positive effects on knowledge sharing as

[8] We use the terms knowledge sharing, knowledge exchange and knowledge transfer interchangeably throughout this chapter.

it has on other learning activities (Bock *et al.* 2005; Burgess 2005; Foss *et al.* 2009; Quigley *et al.* 2007; Vallerand and Bissonnette 1992; Vansteenkiste *et al.* 2004). This is supported by scholars who have argued that intrinsic motivation promotes knowledge sharing (Cabrera *et al.* 2006; Lin 2007; Osterloh and Frey 2000). Hence, building on the insights from this literature, we suggest that employees who are intrinsically motivated are more likely to share knowledge (Lin 2007).

Existing research has taken an individual's **connectedness** as one of the most eminent indicators of an individual's position in a network. Connectedness indicates the ease with which someone can connect with any other alter in a network. Being well connected either directly or indirectly, allows one to access information and muster support (Bala and Goyal 2000). Well-connected individuals in a network are more likely to contribute to the development of relevant knowledge (Sparrowe *et al.* 2001; Wasserman and Faust 1994).Well-connected individuals receive information and insights from many others, of higher accuracy, and are more innovative than individuals that are positioned less strategically (Aalbers *et al.* 2012; Brass 1984; Dekker *et al.* 2003; Ibarra 1993). Well-connected individuals can collect and spread existing information more rapidly, but can also recombine existing ideas and knowledge in a novel way thus being more creative (Burt 2004; Sparrowe *et al.* 2001).

Individual connectedness and **motivation** are argued by some to be conceptually and empirically connected. Linking motivation to network connectedness may increase our understanding of intra-organizational knowledge transfer. Social integration may not mean that an individual is directly connected to all other colleagues, however. He or she may be able to reach others indirectly. Katz (1964) observed that those who are well connected into networks of social relationships in a professional environment will be more likely to participate in decision making, and see clearly how they contribute to group performance. Teigland (2009) extended this notion to cooperation patterns in a multinational corporation setting and found that individuals who maintain more social relationships with their peers will be more vital in the overall knowledge flows across the organization (see also Nerkar and Paruchuri 2005). Moch (1980) observes that intrinsically motivated individuals are more socially integrated. The degree to which an individual is favorably positioned in the knowledge sharing network, in particular, is expected to be driven by intrinsic motivation for a number of reasons. Someone who is intrinsically motivated to share knowledge is more likely to volunteer knowledge that might be relevant for an alter.

In response to a request for knowledge from her social environment, an intrinsically motivated individual will be more likely to provide knowledge above and beyond what is asked for as the sharing of knowledge in itself is perceived as fulfilling (Constant *et al.*1996). Intrinsically motivated individuals will also be approached more often to provide knowledge because alters expect that no immediate quid pro quo is expected or negotiated for; they are trusted more (Burt 2005; Hansen 1999). In the context of innovative knowledge transfer these reasons to expect intrinsically motivated individuals to be involved will be stronger still. In such a context, no immediate return to time and effort invested in knowledge transfer is to be expected and economic payoffs are highly uncertain (Dolfsma and Van der Eijk 2010).

Hence we argue that intrinsic motivation is a useful predictor of an individual's connectedness in the innovative knowledge sharing network:

> ***Proposition 1:*** *The degree to which an individual is highly connected within the innovative knowledge exchange network he partakes in, is determined by his intrinsic motivation.*

4.3 Knowledge transfer within the organization: inter-unit relations and motivation

Aside from the benefits for the individual employee of being connected well in the intra-organizational innovative knowledge transfer network, organizational innovative knowledge sharing benefits from diversity of relations (Whelan *et al.* 2011). The number of such diverse contacts outside one's own unit determines to a large extent the degree to which an individual has the potential to contribute to the innovative capacity of the organization (Tsai 2002; Perry-Smith and Shalley 2003). Spanning unit boundaries provides access to diverse sources of knowledge to an individual and its organizational unit and is critical for an individual's innovativeness within an organization (Aalbers *et al.* 2012; Burt 2004). Participation in cross-functional activity by individuals, for instance, increases their access to alternative views on a firm's existing strategy, goals, interests, time horizon, core values and emotional tone (Floyd and Lane 2000) but also extends their basic complementary functional expertise. Exposure to conflict and discussion as a result of different needs, objectives and interests between differentiated organizational units and hierarchical

levels, is believed to increase ambidexterity at the individual level (Mom *et al.* 2009). In sum, making sure one maintains diverse relations holds various benefits to the individual.

Employees are most likely to interact with others in their immediate surroundings. Interacting with others, beyond the immediate contacts or beyond whom one would as a matter of course meet regularly is more costly. Although the number of ties maintained might be viewed upon as an indicator of the strength of an agent's position (Freeman 1979), establishing and maintaining ties is costly too (Buechel and Buskens 2012). To expect that more ties will necessarily be better seems unrealistic, even if maintaining them is intrinsically motivated. Investment in (the expansion of) one's network might become uneconomic especially when an individual is already supporting many ties.[9] These costs might surge in particular when ties span unit boundaries (Tsai 2000; Haas and Hansen 2005). An effort must be made to arrange a meeting to establish or maintain a contact. In addition, an employee that acts outside his immediate surrounding is likely to have a different social or professional thought world that can be difficult (costly) to relate to. The diversity of or cognitive distance between specialized knowledge developed in separate units is larger than within a unit (Nooteboom 2000). In addition, knowledge transfer across unit boundaries tends to involve relatively less familiar others. Levels of trust may be lower between individuals from different units who interact. The result may be that more uncertainty is involved in inter-unit knowledge transfer when compared to intra-unit knowledge transfer. A high risk high yield environment that characterizes an innovation setting where inter-unit knowledge transfer with relatively less well known others is involved, might in particular be an environment where individuals motivated by immediate personal returns to knowledge exchange, such as career progression, status or financial rewards, will engage in knowledge transfer (Osterloh and Frey 2000; Kankanhalli *et al.* 2005; Lin 2007). Indeed, studies of network connectedness find that the value of each connection maintained decreases with its distance, while the costs of establishing and maintaining them increases, ensuring

[9] The benefit of being well-connected by being on the shortest path to others in the network (having a low closeness score) and of having diverse inter-unit ties should therefore be analysed while controlling for number of an individual's immediate ties.

that actors in general strive to connect with others at a short distance (Jackson and Wolinsky 1996; Hummon 2000; Doreian 2006).

Differentiating between inter- and intra-unit knowledge transfer is common to social network studies and has provided some interesting insights regarding social capital, value creation and innovation (Tsai and Ghoshal 1998; Tsai 2002; Paruchuri 2010; Mäkelä and Brewster 2009). When employees are to be actively encouraged to establish and maintain diverse, inter-unit ties, they may then need to be stimulated by relating to their immediate personal and professional interests (Amabile 1997). Yet, the implied distinction between what motivates inter- and intra-unit knowledge transfer is implicit in the literature. Based on the previous arguments, we propose that the increased perceived uncertainty and costs involved in inter-unit knowledge transfer form the prime reason why inter-unit knowledge transfer may in particular appeal to an individual's extrinsic motivation. Therefore we pose the following proposition:

> ***Proposition 2:*** *The number of inter-unit ties an individual holds in the innovative knowledge exchange network is determined by his extrinsic motivation.*

4.4 Method and data

Organizational setting

Recognizing the need of more empirical support for the theoretical findings to underscore the importance of inter-unit communication structures (Hansen and Haas 2001), this chapter draws upon empirical research collected at two separate companies. One is a subsidiary of a European electronics and engineering conglomerate (Alpha Company), the other a leading European financial service provider (Beta Company).

Alpha Company is a multinational electronics and engineering company headquartered in Europe. We study the Dutch subsidiary, which has been in operation since the late 19th century and employs around 4000 employees. Alpha Company is organized according to a unit structure with a high level of autonomy and responsibility for the separate units. The units are organized according to product-market segmentation. Recently, the company shifted its strategic insights

from offering specific products towards offering 'total solutions' to its customers. As the company now aims at offering integrated and innovative solutions based on its technical competencies that cross unit boundaries, this heightens the relevance of internal knowledge exchange and the network that facilitates it. The unit structure constitutes a natural membership boundary (see Hansen 1999), however, and it is therefore that employees, sorted by unit membership, form the object of analysis in this study of inter-unit transfer of knowledge. The selection of these units is carried-out based on the input gathered during several interviews with the new business development director and the business managers in the separate units. Through the new business development director the commitment of the unit directors was sought and secured.

Beta Company is one of Europe's largest and most innovative payment processors, leading the market for secure payments and card processing solutions. We study its headquarters. With an annual processing volume of almost 7 billion payments and the switching of 1.9 billion POS and ATM transactions, the company's market share within the Eurozone is well over 10%, employing 1500 employees; with the large majority based in its European headquarters. Beta Company is characterized by a strong unit structure. Again access was negotiated through the director of the new business development unit, operating directly under the supervision of the board of directors.

Data collection process

To test the formulated propositions, data on the social relations within both companies are gathered on individuals involved in the innovation network. We follow Farace *et al.* (1977) to define social networks as repetitive patterns of interaction among members of an organization. Data on the individual level of the innovative knowledge exchange network, hereafter referred to as the innovation network, are collected using semi-structured interviews with managers and other employees as well as by means of an egocentric network survey. The interviews served a two-fold purpose: first, to become familiar with the organizational setting and thus gain input for the proper design of the network survey and second, to determine the appropriate response group within the company. In social network studies the most pragmatic approach in an organizational setting is believed to be the survey methodology (Borgatti and Cross 2003; Wasserman and Faust 1994). We use snowball

methodology as the basis for this survey. Snowball sampling is especially useful when the population is not clear from the beginning (Marsden 1990, 2002; Wasserman and Faust 1994), which is the case for both organizations studied here. Innovative concepts may arise from employees who are not part of a cross-unit team set up to stimulate innovation, for instance, or it may arise from interactions not mandated by management. Snowball sampling is based upon several rounds of surveying or interviewing where the first round helps to determine who will be approached as a respondent in the second round, and so on. The first round of snowball sampling can be totally random but it can be also based on specific criteria (Rogers and Kincaid 1981). To reduce the risk of 'isolates', i.e. isolated persons within the organization who do possess relevant knowledge to a particular subject, but who are being left out by the study due to the lack of accuracy of random sampling (Rogers and Kincaid 1981), this study opted in a first round to target respondents selected in conjunction with new business development management.

The networks analyzed are egocentric networks, an approach commonly adopted for the purposes of this kind of research. The survey was first tested on a small sample of respondents whom had been personally informed of the purpose of the study to increase their level of cooperation. The final version of the survey was sent in three rounds in each of the companies. The names mentioned at Alpha Company by this first round of respondents (9) formed the input of respondents for the second round (42), who named another round of respondents. Closure was reached after this third round of surveying. The full network studied consisted of 83 employees partaking in the knowledge sharing network, with a joint number of 122 individual innovative knowledge transfer ties. The final overall response rate at Alpha Company was 96%. Only 4% did not respond to the first mailing and the later three reminder mailings. Following an identical procedure a comparable response was achieved at Beta Company, with an overall response of 93%. With 30 employees at Beta Company partaking in round one, which named another 54 employees that together formed the second survey round, the total innovative knowledge sharing network at Beta Company showed to comprise of 144 employees. This innovation community together maintained 381 individual innovative knowledge transfer ties.

The invitation to participate in the survey was distributed by email at each of the companies, accompanied by a personalized cover letter introducing the project and the hyperlink to the online survey to the respondent, signed by the senior new

business development manager to improve response rates. An online survey was chosen to reduce the time needed to complete the questionnaire, thus improving response rates. We did not opt to fix the number of contacts throughout the survey by using a list of names provided by management or to indicate a limit to the number of possible contacts a respondent could list (Friedman and Podolny 1993). However, we did issue a guideline of naming six employees to make sure that only the most important contacts per employee were mentioned. To reduce ambiguity regarding the interpretation of the questions by the respondents, the network questions were formulated in the native language.

Variables

For each of the employees partaking in the knowledge exchange network we collected input for each of the variables. The innovative knowledge sharing network was measured by asking individual respondents with whom they initiate a discussion of new ideas, innovations and improvements regarding corporate products and services (Borgatti and Cross 2003; Cross and Prusak 2002; Rogers and Kincaid 1981; Stephenson and Krebs 1993; Rodan 2010). Based on the network data gained via the egocentric survey, the dependent variables of closeness centrality and interunit ties were calculated, using Ucinet 6.0 (Borgatti *et al. 2*002; Freeman 1979).

Dependent variables

Individual connectedness

Individual *connectedness* was measured by means of individual closeness centrality (Costenbader and Valente 2003; Freeman 1979). Closeness centrality takes the structural position of actors in the whole network into account, and has been identified as one of the most important centrality measures in network analysis (Borgatti 2005). Closeness centrality measures how many steps on average it takes for an individual to reach everyone else in the network. Individuals who have high closeness centrality can most efficiently make contact with others in the network (Freeman 1979; Costenbader and Valente 2003, p.298). The higher one's closeness centrality, the better positioned the individual is in dispersing information to others (Wasserman and Faust 1994). In this study closeness centrality is preferred to degree centrality, as it does not take into account only direct connections among units but also indirect connections. An individual's closeness centrality is the inverse of an

individual's closeness score, which is calculated[10] as the sum of graph-theoretic distances from all other individuals in the network, where the distance from one individual to another is defined as the length (in links) of the shortest path from one to the other (Freeman 1979). Closeness is an inverse measure of centrality, a larger value indicates a less central actor while a smaller value indicates a more central actor. For this reason we normalize the centrality score, following Borgatti and Halgin (2011), by dividing raw closeness by its maximum score in the database and extract this score from 1, which simultaneously reverses the measure so that high scores indicate greater connectedness. This allows for easier interpretability of the results as well. Assuming that what knowledge flows in a network originates from all other nodes with equal probability and travels along the shortest path, highly central individuals have short distances from others, and so will tend to receive innovative information flows sooner (Borgatti 1995, p.59).

Number of inter-unit ties

The number of inter-unit ties was calculated based on data from the egocentric network survey. This variable was constructed from the number of ties outside the unit, but inside the boundaries of the organization, that the individual employee maintained in the previous three months (Tsai 2000). We normalized this measure by dividing each individual score by the maximum in the dataset.

Independent variables

The independent variables *intrinsic and extrinsic motivation* were derived from the Work Preference inventory of Amabile (1994). The Work Preference Inventory (WPI) is specifically designed to assess individual differences in intrinsic and extrinsic motivational orientations (1994). The questions of the inventory are specifically aimed to assess the major elements of intrinsic motivation (self-determination, competence, task involvement, curiosity, enjoyment, and interest) and extrinsic motivation (concerns with competition, evaluation, recognition, money or other tangible incentives, and constraint by others). Drawing from a total repository

[10] Closeness of a node is equal to the total distance (in the graph) of this node from all other nodes. As a mathematical formula closeness, c(i), of node i can be written as: $c(i) = \sum_j d_{ij}$ where *dij* is the number of links in a shortest path from node *i* to node *j*.

of 30 propositions, Amabile points out that to fit the context of the study we should match our findings accordingly. In this study we draw from 6 propositions on intrinsic motivation and 6 propositions on extrinsic motivation. These propositions were converted in 12 questions for the questionnaire, framed on 7 point Likert scales. The Cronbach alpha for the intrinsic motivation questions was 0.62, the Cronbach alpha for the extrinsic motivation questions was 0.58. For 33 percent of our respondents we were able to collect motivational data on both intrinsic as well as extrinsic motivational antecedents.

Control variables

Four variables were included as controls: *tenure* (in months), *gender*, *unit membership*, and *number of ties* per individual employee. We included tenure to control for the effect of time, as relations tend to develop throughout the years. Gender and unit membership were added to control for group affiliation effects. Number of ties per individual employee was included to control for the effect of individual network size and the corresponding maintenance and opportunity costs (Buechel and Buskens 2012; Tsai 2000; Haas and Hansen 2005). We normalized this variable by dividing each score by the maximal score reported.

4.5 Results

Since aggregating the data for the two firms in our study into a single dataset is both methodologically as well as substantially meaningless, we provide analyses for each of them separately. Descriptives are presented in tables 4.1a and 4.1b and show the means, standard deviations, and zero-order correlations of each of the variables for each company. Moving beyond these zero-order results, the multiple regression analyses summarized in Table 4.2 and 4.3 represent the tests of our first and second proposition, for each company[11]. To make sure that the sample size did not lead to a

[11] In social networks observations are, by definition, not independent. This violates an important assumption that underlies most standard statistical techniques. However, although we know that the independence assumption is violated in social network data, it is generally unknown to what extent this affects parameter estimation and inferences. Over the recent years, advances have been made in the development of statistical analysis techniques well-suited for social network data (most notably ERG-models, Siena, p-star, and QAP), but none of these models are suited for the testing of the specific

violation of the normality assumption central to the ordinary least square procedure we used, we checked for non-normal distributions and examined the skewness and kurtosis of all the variables. The skewness and kurtosis showed no values greater than an absolute value of one (1) for each variable, suggesting reasonably normal distributions. Histograms for each variable were also examined, however, and these showed that most scales were moderately positively skewed, with floor effects evident for number of inter unit ties which appeared to violate the assumption of normality. Thus a square root transformation was computed. The regression analyses were conducted using both the nontransformed and transformed scores and this was not found to make a statistically significant difference to the variance explained or to the regression coefficients. For simplicity and interpretability of the findings reported upon, only the non-transformed scores are presented. Homoscedasticity was examined via several scatterplots and these indicated reasonable consistency of spread through the distributions. Multiple linear regression analysis was deployed to determine which of the motivational attributes predicts connectedness (closeness centrality) and number of inter-unit ties per employee in the knowledge sharing network.

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hypotheses in this chapter. We therefore decided to present results based on the OLS-framework in this chapter, because it allows one to present readily interpretable results. Statistical theory suggests that the parameter estimates in the OLS model are likely to have little bias. The lack of independence of our observations is, however, likely to affect the width of confidence intervals and, as a result, may make inference based on OLS models lack in conservatism. To address this OLS shortcoming, we conducted a bootstrap procedure (Snijders and Borgatti, 1999; Davison and Hinkley, 1997; Efron, 1979; Efron and Tibshirani 1986) to estimate empirical confidence intervals, both parametrically and nonparametrically. In particular, we conducted an m-out-of-n bootstrap (Bickel and Ren 1996; Bickel, Goetze and Zwet 1997), based on 10000 resamples, each with a size of 50 percent of the original sample drawn with replacement. The m-out-of-n approach was chosen because it strongly reduces potential dependence effects in the data. Unfortunately, the m-out-of-n approach does tend to make confidence intervals somewhat wider and, consequently, p-values more conservative than necessary. This can be considered a drawback, but it also suggests that any statistically significant result that "survives" the m-out-of-n bootstrap has to be a strong and valid effect. The fact that most of our substantively relevant findings stood up to this bootstrap approach, suggests that these effects are pervasive and are unlikely due to the lack of observation independence in our data.

	Means, Standard Deviations and Correlations								
Variable	**Mean**	**Std. Dev.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1 Gender	0.925	0.267							
2 Tenure	10.666	6.325	0.099						
3 Unit	2.222	1.251	-0.064	0.078					
4 Ties (#)	4.810	3.680	0.26	-0.087	-0.083				
5 Closeness centrality	0.127	.175	-0.692**	-0.27	-0.045	-0.182			
6 Intrinsic motivation	3.735	0.481	-0.059	-0.233	0.07	0.087	0.235		
7 Extrinsic motivation	2.957	0.516	0.302	0.288	0.214	0.181	-0.564**	0.124	
8 Inter-Unit ties	1.370	2.151	0.117	-0.05	0.083	0.636**	-0.05	0.08	0.246

Table 4.1a: Descriptive statistics Alpha Company

*N=28; ***, ** and * indicates a significance level of 0.1%, 1% and 5% respectively.*

	Means, Standard Deviations and Correlations								
Variable	**Mean**	**Std. Dev.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1 Gender	0.793	.409							
2 Tenure	7.450	4.654	-0,20						
3 Unit	2.31	1.547	0,20	0,01					
4 Ties (#)	10.43	6.754	0,06	-0,44	-0,11				
5 Closeness centrality	0.145	.229	-0,03	0,22*	0,14	-0,31***			
6 Intrinsic motivation	5.155	1.105	0,24*	-0,11	-0,02	0,04	-0,29***		
7 Extrinsic motivation	4.270	1.246	0,05	-0,02	0,09	-0,18	-0,11	0,19	
8 Inter-Unit ties	3.590	3.656	-0,28*	0,15	-0,14	0,61***	-0,16	-0,03	-0,23*

Table 4.1b: Descriptive statistics Beta Company

*N=58; ***, ** and * indicates a significance level of 0.1%, 1% and 5% respectively.*

The results of the multiple regression analyses, presented in Table 4.2, are remarkable. After running the model with the control variables in isolation and after controlling for the specific effect of number of ties as a proxy of an individual's economic investments into his social infrastructure, models A3 and B3 introduce intrinsic motivation. The inclusion of intrinsic motivation in explaining individual

connectedness results in a significant improvement to the regression model at Beta Company (Model B3; F-test for $\Delta R^2 = 4.645$, $p<0.05$), identifying the relationship as significant (Model B3; beta-.278, $p<0.05$). The sign for the effect found in the case of Alpha Company is actually opposite to the one found for Beta Company. The effects found for Beta Company are not statistically significant, however. We interpret these findings as indicating that proposition 1 has to be rejected.

In models A4 and B4 we introduce extrinsic motivation as well. An individual's motivation is not a dichotomous matter, as we argued above, but might very well be based on a combination of both intrinsic and extrinsic motives. The introduction of extrinsic motivation does not provide a statistically significant beta and, in line with that, does not significantly improve our model B4 results for Beta Company as a whole. A significant positive relationship between extrinsic motivation and connectedness does show for Alpha Company (Model A4; beta=-.419, $p<0.01$). The role of motivation for determining connectedness of individuals in a knowledge transfer network seems to be quite different for the two companies involved, suggesting that contingent elements may be at play beyond the scope of current research on motivation and involvement in knowledge transfer. From among the control variables we include, it is striking to see how women at Alpha Company are more likely to be located in the network close to potential sources of knowledge. As this effect appears to be limited to Alpha Company only, we refrain from further speculation on the causes of this apparent relationship. What is more striking is the lack of significance for the control variable Tenure: one would expect that individuals are more likely to have developed more relations as they have been employed at a firm for a longer period of time, including relations with 'distant' colleagues. This is not the case. In addition, being well-embedded locally, having a large number of direct ties in the knowledge transfer network, does not make an employee well connected indirectly, at the network level.

Our second proposition looks at what explains the number of inter-unit ties an individual has in the knowledge transfer network. Inter-unit ties have been found in the past to contribute to innovation in particular. Table 4.3 reports results of the multiple regression analyses for the datasets. Contrary to expectation, neither intrinsic nor extrinsic motivation of individuals predicts their involvement in

knowledge transfer across unit boundaries.[12] The third and fourth model that add the motivation variables in comparison to the base models 1 and 2 offer no significant improvement as judged by the F-test for ΔR^2. Betas are non-significant for both types of motives and so proposition 2 must be rejected as well.

D.V:	**Closeness centrality ‡** Alpha Company				**Closeness centrality ‡** Beta Company			
I.V:	**Model A1**	**Model A2**	**Model A3**	**Model A4**	**Model B1**	**Model B2**	**Model B3**	**Model B4**
Tenure	.197	.201	.163	.036	-.139	-.115	-.097	-.106
Unit	.073	.075	.090	.003	-.215	-.104	-.087	-.074
Gender	.678***	.669***	.660***	.551***	.012	.015	-.053	-.051
Ties (#)		.032	.47	.012		.250	.251	.278
Extrinsic Motivation				.419**				.123
Intrinsic Motivation			-.168	-.245*			.278*	.254
N	28	28	28	28	58	58	58	58
F-value	8.495***	6.117**	5.192**	7.195**	1.286	1.742	2.418*	2.157
R^2	.526	.527	.553	.683	.067	.116	.189	.202
Adjusted R^2	.464	.440	.446	.588	.015	.049	.111	.109
F-test for ΔR^2		.044	1.233	8.249**		2.968	4.645*	.881

Table 4.2: Motivation and closeness centrality (Connectedness ‡) – Proposition 1 Tested

*[a] Standardized coefficients. * p<.05, ** p<.01, *** p<.001; Durbin Watson model A: 1.837, VIF<1.34, Tolerance >.74; Durbin Watson model B: 1.877, VIF <1.31, Tolerance >.75. ‡ Connectedness is operationalized as normalized closeness centrality at the employee level (see Section 4).*

Entered as a control in model 2, the sheer number of ties seems to be the best predictor of the inter-unit ties an individual maintains in the innovation networks at both companies. Statistically, the relation remains significant in each of the models where this variable is included.

Gender negatively impacts the number of inter-unit ties an individual has in a statistically significant way only for Beta Company. Also departmental affiliation appears to matter in explaining the maintenance of inter-unit ties at Beta Company

[12] Analysis of contribution from motivation -extrinsic and intrinsic- explicitly limited to intra-unit knowledge transfer provides similar findings.

only. Again, and again surprisingly, having enjoyed a long tenure at a company does not lead an employee to have more inter-unit ties.

D.V:	Inter-Unit Ties Alpha Company				Inter-Unit Ties Beta Company			
I.V:	**Model A1**	**Model A2**	**Model A3**	**Model A4**	**Model A1**	**Model A2**	**Model A3**	**Model A4**
Tenure	-.070	.002	-.036	-.040	-.092	-.009	-.006	-.001
Unit	.096	.134	.102	.103	.106	.478**	.471***	.473***
Gender	.130	-.046	-.082	-.084	-.242	-.232**	-.230*	-.244**
Ties (#)		.659****	.636***	.637**		.838***	.825***	.823***
Extrinsic Motivation			.144	.147			-.057	-.068
Intrinsic Motivation				-.015				.059
N	28	28	28	28	58	58	58	58
F-value	.210	4.59**	3.308*	2.628*	1.934***	25.101***	19.969***	16.551***
R^2	.027	.425	.441	.441	.097	.655	.658	.661
Adjusted R^2	-.100	.320	.307	.273	.047	.628	.625	.621
F-test for ΔR^2		15.219***	.601	.007		85.522***	.462	.473

Table 4.3: Motivation and Inter-unit ties – Proposition 2 Tested

*[a] Standardized coefficients. * p<.05, ** p<.01, *** p<.001; Durbin Watson model A: 2.665, VIF<1.35, Tolerance >.88; Durbin Watson model B: 1.874, VIF < 1.30, Tolerance >.76.*

4.6 Discussion and conclusion

Connectedness and inter-unit ties in the knowledge transfer network are both known to allow individuals to contribute to innovation (Burt 1992; Tsai 2001). For this reason it is important to understand what explains who is likely to be thus favorably positioned. Literature strongly suggests that individuals' motivation should be expected to be an important explanatory factor for people's favorable position in a knowledge transfer network. Intrinsic motives are strongly suggested to lead individuals to be actively involved in innovative knowledge transfer. Actors in a relatively large organization tend to be members of exogenously-defined sub-units, but this group membership has rarely been taken into account when empirically studying knowledge transfer thus far. A germane question from an innovation policy

perspective then is to determine what makes individuals transfer relevant knowledge across unit boundaries. The expectation is that such more risky and costly behavior may be motivated in particular by extrinsic motivation.

A main strength of this research is to be able to present findings of actual knowledge transfer in multiple firms so firmer conclusions may be drawn than those conducted previously under the controlled setting of an experiment in which, e.g., students participate (Quigley *et al.* 2007). In this study we find that an individual's motivation is implicated in these aspects of knowledge transfer in a different way than was expected. Intrinsic motivation actually does *not* play a role in determining connectedness nor in the number of inter-unit ties in the knowledge transfer network. The effects found for extrinsic motivation are equally ambiguous. This might come to some as an unwelcome surprise as motivation is commonly viewed as an aspect of human behavior which scholars have started to understand and managers can use as an intervention tool. This, we suggest, is not true in the context of knowledge transfer.

Future research

Further research, specifically looking at the longitudinal developments, could shed additional light on this issue. Results found for the predictors and control variables vary between the different firms analyzed. This may suggest that contingent factors not so far included in research of knowledge transfer and individual motivation may be at play (cf. Lin 2007). The mutually interdependent nature of motivations, actions and positions in a social environment may need to be more explicitly incorporated in an analysis in future research (Teigland and Wasko 2009). Including reciprocal benefits as an extrinsic motivator (Lin 2007; Kowal and Fortier 1999) might not adequately recognize the interdependencies and socially embedded exchange or transfer of knowledge over time (Bouty 2000; Ensign 2009). The fact that the sheer number of ties that a person has is the important predictor for someone to have inter-unit ties is an indicator of this. Motivation to transfer knowledge across unit boundaries might particularly involve a mixed bag of motives in an exchange that can involve ritualized behavior that is not captured by the variables included here (Dolfsma *et al.* 2009; Ensign 2009). It might be more important for partners in knowledge transfer to have valuable knowledge to exchange (so as to call in a return

favor later) than what motivates them to exchange in the first place (Bouty 2000; Ensign 2009).

Managerial implications

The organizations we studied are large multinationals and would resemble other such large firms in relevant respects. The full extent to which our findings are representative is difficult to determine, however. Social networks analysis is necessarily restricted to quantitatively studying single cases: social network analysis is highly demanding of the data required for proper analysis, and data across different firms cannot be meaningfully aggregated. The social network literature has by now, however, generated a large number of studies covering a wide variety of topics that touch upon the findings our study presents. A large body of knowledge has in the meantime emerged that is robust and allows one to suggest managerial implications as well.

The most salient implication for innovation management is that motivation does not seem to be much implicated into knowledge transfer, especially for transfer across unit boundaries. Individuals who are extrinsically motivated, however, will find themselves just slightly less well positioned to transfer knowledge especially within the boundaries of a unit. Enticing employees to engage in inter-unit knowledge transfer seems not to be impeded by the higher costs and risks involved. Innovation policy may thus fruitfully focus in particular on other individual characteristics such as skills (cf. Kaše *et al.* 2009) or on routines to be established in a firm (Zollo and Winter 2002; Van Driel and Dolfsma 2009). Further research, specifically of a longitudinal kind, is required to explore the conclusions and suggestions we offer in this chapter.

Chapter 5

Creating Employee Networks That Can Deliver Innovation: The Role of the Idea Scout and the Idea Connector[13]

5.1 Introduction

Companies such as Procter and Gamble, Cisco Systems, Genzyme, General Electric and Intel are often credited with having attained market leadership through open innovation strategies. That is, by tapping into and exploiting technological knowledge that resided beyond their own research and development structures, these companies outmaneuvered rivals that relied largely on in-house approaches to innovation. But while other organizations try to follow the example set by these trailblazers, our research shows that many are failing because they neglect to ensure that the outside ideas reach the people best equipped to exploit them. There is a way to change this path for the better. By understanding the roles of two types of innovation brokers – 'idea scouts' and 'idea connectors' – in the open innovation process, and by utilizing their talents effectively, managers can preside over major improvements in the conversion of external knowledge into innovative outcomes.

[13] This chapter was published in *MIT Sloan Management Review* (2011) as "Creating Employee Networks That Deliver Open Innovation", 53(1): 37-44, co-authored with E. Whelan, S. Parise and J. de Valk. We are grateful to Thomas Allen and the other participants of the Open Innovation Symposium 2011 for their constructive comments on an earlier version.

5.2 About the research

The insights presented in this chapter are based on our research and consulting work over the past years with a number of leading companies in a variety of industries. These industries include high-tech engineering (Philips, Siemens, Boston Scientific, Creganna), information and communication technology (Microsoft, Intel, Atos Origin, TED), energy (Royal Dutch Shell, Chevron), management consulting (Deloitte) and financial services (ING, Equens). Our work has centered on understanding how opportunities for innovation diffuse throughout interpersonal networks. To examine this process, we used organization network analysis techniques to visualize networks, identify the key innovation brokers and discover any underutilized potential. We then conducted interviews with over 80 innovation brokers to get a deeper appreciation of their attributes and the roles they perform. We also took measures of personal innovation and correlated them with network position, sources of knowledge used and personal factors such as tenure and area of expertise. Finally, we studied the use of social media and Web 2.0 technologies in the innovation process in over 30 organizations by using interviews, surveys and network-analysis techniques.

5.3 The relevance

After setting the research background, the remainder of this chapter will address a number of illustrative cases that provide a detailed insight in the current world of the idea scout and idea connector. Let us start with considering the case of a software company that specialized in developing solutions for multimedia customer-contact centers. Because the pace of technological change in this particular field is extremely rapid, competitors need to continuously identify and integrate emerging advances in communication technologies from the outside world. This particular company lost a major client contract to a rival primarily because the rival's product featured more advanced voice-recognition capabilities. During the course of our work with the company, we discovered that the very voice-recognition technology displayed in the rival's product was actually identified by one of the company's software engineers almost a year earlier. The engineer in question had learned of the new technology from a working paper published on a university lab's website. Realizing its potential, she immediately brought the new development to the attention of her team leader.

However, this opportunity developed no further. To determine why this idea came to naught within the company's internal R&D network, we used organizational network analysis, or ONA[14], which revealed the team leader to be a peripheral player in the network structure. Even if he had genuinely wanted to incorporate the new voice-recognition capability, he lacked the trusted personal connections to see it through. Where this company failed was where its rival obviously succeeded – in ensuring that an outside idea got to the right point in the network, where it could be assessed and ultimately exploited.

5.4 Idea scouts and idea connectors

The previous example illustrates on of the key challenges faced by many R&D driven organization under current market conditions of ever shortening time-to-market cycles and increasingly globalized competition. R&D leaders need to think not only about combining the outside world for new and potentially applicable ideas but also about how to ensure that those ideas reach the people able to develop them in innovative ways. Organizations that are smart in this regard invest in both the idea scout and the idea connector. Another company we worked with was a leading player in the medical-devices industry – in particular, our client was an R&D unit assigned to advance the company's stent-delivery technology. To maintain its leadership position in this arena, the management team understood the importance of identifying and exploiting emerging ideas from industries as diverse as electronics, pharmaceuticals and plastics. Yet it lacked a coherent structure for doing so. In the words of the R&D director, *"Knowledge flow is the lifeblood of our division, but it is invisible to us. [I]t all happens informally."* With the aid of ONA, we proceeded to ascertain the R&D unit's network connections that facilitate open innovation. Figure 5.1 conceptually illustrates the playing field of both connector and idea scout and is illustrative for the type of patterns of innovative collaboration we were able to study.

[14] See the section – *ONA: A Tool Adapted From the Social Sciences* – at the end of this chapter – for more background on the particulars of the research method applied.

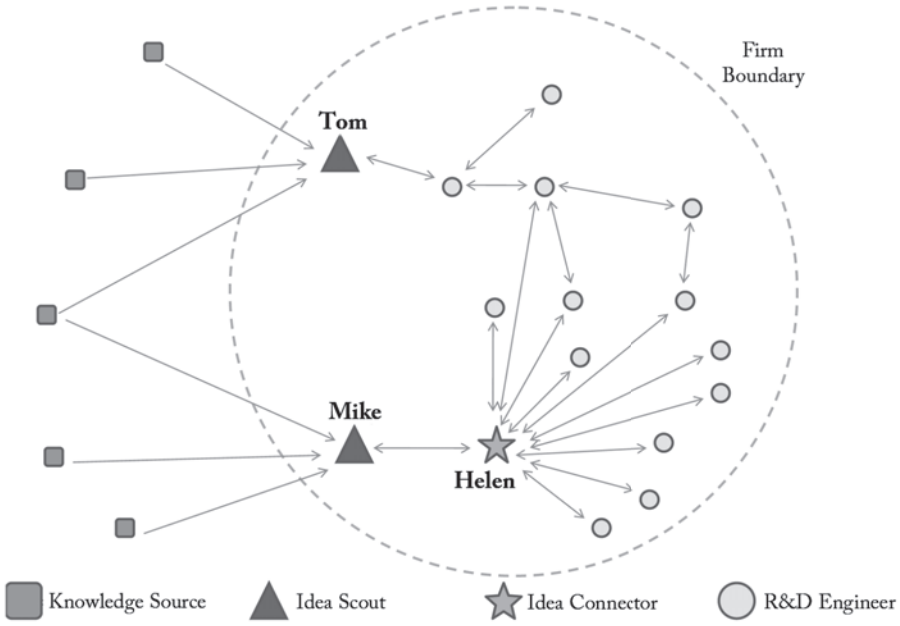

Figure 5.1: The connector's critical role

Highlighted in the diagram are Tom and Mike (idea scouts) and Helen (an idea connector). Both Tom and Mike are idea scouts who have well-developed knowledge and social networks outside their company but limited networks within it. Because Mike is linked to Helen, an idea connector with extensive contacts within the organization, the outside ideas he identifies have developed much more often than Tom's into useful processes, products or services for the company. Let us now consider both roles in more detail.

Idea scouting

Idea scouts such as Tom and Mike are integral to the open innovation process. They act as the R&D unit's antennae, tuned to emerging scientific and technological developments that are broadcast from around the globe. But while idea scouts are very well connected to knowledge sources outside the company we have found that they tend to possess very few strong connections internally (Whelan *et al.* 2010). Without this effective internal distribution network, their contributions to an open innovation strategy are limited. This was exactly the situation that faced Tom. In an

interview, he explained that through his scouting activities he often becomes aware of emerging technological developments that have potential value for the company. While he attempts to distribute such information throughout the internal network himself, he acknowledged that his efforts often fail: The opportunities he identifies are not considered, let alone exploited, by the R&D unit. Tom's distribution efforts usually involve his sending out a blanket email to 20 or so colleagues. However, his R&D colleagues explained to us that because they suffer from 'inbox overload', if an email does not appear to be directly relevant to them, it is usually deleted. Thus Tom's idea-scouting abilities, though vital to the company's innovation objectives, are largely wasted, as he lacks an effective distribution channel. Contrast Tom's case with that of Mike. Like Tom, Mike is an idea scout who has few strong connections internally. However, a major difference between the two is that Mike is linked to Helen -an idea connector who does have an extensive network together with the know-how needed to distribute the technological information that Mike acquires.

Idea connecting

Connectors such as Helen are the hub of the company's social network, the go-to people of the organization (Parise *et al.* 2006). Much of their expertise lies in knowing who is doing what. When they are made aware of an opportunity for innovation, connectors not only know who in the company is best equipped to exploit that idea but also possess the social capital needed to rapidly deploy the network to meet that particular challenge. Indeed, Helen was able to provide us with a recent example of network-based open innovation in practice. Through his scouting activities, Mike had learned of a new development in ultrasonics that was being used in the aerospace industry. He discussed this technology with Helen, and after considering how the R&D unit might profit from it, she informed two other colleagues who she knew were trying to solve a particularly complex problem: how to bond certain medical plastics without using the traditional methods of heat or adhesives. After considering and ultimately modifying the new ultrasonics technology, they were able to develop a solution and have even applied for a patent to protect their innovation.

5.5 Today's idea scouts especially need complementing

While the importance of network brokers to the innovation process has long been recognized (e.g., Allen 1969; Obstfeld 2005; Aalbers and Dolfsma 2008; Lee 2010), our research shows that their profile is evolving as a result of advances in Web-based communication technologies. Let us consider how the innovation broker looked 30 years ago. In a series of influential studies conducted with the leading R&D powerhouses of the day, MIT Sloan School of Management professor Tom Allen discovered the existence of a small number of R&D professionals who were exceptional networkers both inside and outside their companies (Allen 1977). These rare individuals acted as the gate – hence Allen's term 'technological gatekeeper' – through which knowledge of emerging scientific and technological developments flowed into and throughout the R&D department. That is, they performed the roles of both the idea scout and the idea connector. Fast-forward to today, when much of the needed information can be acquired from the Web. The 40 or so idea scouts we have interviewed explained that Web resources – such as online forums, RSS feeds, industry blogs and search engine inquiries – are the primary means through which they keep abreast of emerging technologies and industry trends. Indeed, we found that idea scouts are roughly three times more likely to learn of such developments through the Web than through a personal extramural contact. This easy access to an abundance of information has led the traditional gatekeepers to have to undergo specialization as well as a division of labor. With so much 'smog' on the Web, identifying the truly novel ideas is a time-consuming and complex process that requires the attention of a specialist idea scout. Yet while the Web and the specialist idea scout are necessary for open innovation, they are not sufficient. More than ever, in-house connectors are also needed to complete the circuit. For example, an apparel company we worked with had started soliciting fashion and product ideas through 'crowdsourcing' – allowing consumers to post ideas, and rate the ideas of others, on the company website. A marketing associate acted as scout by asking the consumers specific questions and then analyzing their answers, as well as their comments and ratings, over time. Initially, the company viewed this effort as a huge success, based simply on the thousands of comments it received within a short period. And the marketing associate was seen as doing a fine job at summarizing emerging themes in the fashion industry, identifying likes and dislikes regarding the company's apparel line and making product recommendations based on consumer sentiment.

However, there was little or no connection between that marketing associate and the key influencers and decision makers across the different product divisions. As a result, several problems emerged. Because the specialized scout had little knowledge of the company's overall strategic directions and visions, she often asked the wrong questions and looked for information and solutions that were not aligned with the company's intentions. Second, many of the recommendations that the scout made (e.g., faster introduction of new fashion lines) were simply not feasible based on the company's operations and the logistics that pertained to its suppliers. Finally, much time was wasted, as the valuable information did not make it to the right decision makers. The scout was communicating to people based on their organizational titles and not on their ability to make product decisions, with the result that many good ideas were never acted on and opportunities were lost. It wasn't until she was complemented by a connector (a product-strategy manager who had been with the company for many years) in the crowdsourcing initiative that useful information found the appropriate decision makers, with the result that many crowd sourced ideas were actually implemented.

5.6 Tackling the 'not invented here' syndrome

Innovation leaders must remember that importing outside ideas is only part of the open innovation challenge. Because new ideas will always encounter internal barriers, leveraging the internal network to actually adopt those ideas is where the idea connector is crucial. Another company we worked with – a leading European electronics and engineering business – was trying to implement open innovation, but it was being stymied by a condition commonly known as the 'not invented here' (NIH) syndrome. This syndrome occurs when R&D professionals build up resistance to an outside idea or technology because they assume that if they did not come up with it themselves, it must not be very valuable. In this case, the NIH syndrome was blocking the company's efforts to transform itself from being 'product focused' to offering a 'total solutions' package to its customers. The new strategy required previously segregated business units to integrate their technical competencies, as management was convinced that every unit possessed knowledge that other units could convert into innovative solutions. However, when we used organization network analysis to measure the extent to which interunit collaboration was occurring, it

revealed that the locus of innovation activity continued to remain at the business unit level. Each unit tended to hoard its own knowledge and rarely sought ideas from its counterparts. The new total solutions strategy, which was essential to the company's future, was unable to succeed at the scale intended. But some flow of ideas between business units was actually occurring, though sporadically, and we found that where it did occur an idea scout and an idea connector were at the fore. For example, in what became a profitable venture for the company, the sharing of ideas between the transportation unit and the mobile applications unit resulted in the ability to offer advanced track-and-trace services to buyers of its luggage-logistics products. This innovative feature was central to the transportation unit's winning of a contract to supply the luggage-logistics system to a major European airport. When we traced how this innovation came about, it was clear that the successful outcome hinged on a connection between a single idea scout and an idea connector. Peter, an engineer in the transportation unit, is the idea scout of the story. He is inquisitive by nature and is constantly searching for new developments both inside and outside the company. He explained that other units may not broadcast what they are working on, but if you are curious enough you can pull the information from them. Through his grapevine network he has access to a number of acquaintances in other business units, and his interactions with these colleagues usually take place around the communal coffee machine, where they trade what they know for what they need. He also utilizes more formal initiatives to secure new insights from around the company; the initial spark for the luggage-logistics service feature came from a client lunch he attended that was organized by the mobile applications unit to promote its new offerings. When a particular radio-frequency identification capability was demonstrated, he immediately sensed the potential that RFID could have if fused with the existing airport conveyor-belt expertise. However, like many other idea scouts we studied, Peter himself lacks the influence and political skills to convert a new idea into a viable project within his own division.

Enter Hans, an idea connector who has the contacts and influence within the transportation unit to ensure that an idea he champions has a good chance of being adopted, thereby helping to break down the NIH syndrome. Not only do these types of brokers connect people; network operators like Hans also often possess the ability to put different concepts together into a potential innovation. Indeed, this is what happened when Peter presented him with the RFID idea. Hans saw an opportunity

to add an extra layer of service to the unit's conveyor-belt technology if RFID could be applied in a certain way. The resulting service feature provided baggage handlers and airport operators with real-time and historical track-and-trace data, giving them an instant overview of the positions of all pieces of luggage.

5.7 Insights for R&D leaders

The innovation brokers identified and analyzed in our research have tended to emerge informally. In many cases, the people who wound up as idea scouts and connectors came as a complete surprise to management. Nevertheless, innovation is too important to be left to chance; if innovation brokers do not exist, management is obliged to 'invent' them – i.e., assign people to perform these valuable roles. Procter and Gamble, for example, has formally appointed idea scouts to seek out new technologies from around the globe (Chesbrough 2003), an approach that is also commonly applied in the apparel and gaming industry.

But at the same time many R&D leaders pursuing open innovation tend to place an undue emphasis only on idea scouting, thereby neglecting how the ideas become meshed with the company's existing capabilities. Because research has shown that breakthrough innovations tend to result from the combination of new and existing knowledge bases (Hargadon 2003), R&D leaders must consider the open innovation process in its entirety. In doing so, they need to recognize that both the idea scout and the idea connector are critical for the successful implementation of open innovation strategies.

How can management be sure it is recruiting and appointing the right people to these positions? Based on our study of emergent innovation brokers, we have described the key characteristics and expertise of idea scouts and connectors which are summarized in table 5.1.

	Idea Scout	Idea Connectors
Expertise	– Ability to identify useful ideas from outside the company – Deep knowledge base of a particular technology space – Strong analytical skills – High information technology literacy	– Ability to connect different concepts in a meaningful way – Wide-ranging knowledge base that facilitates understanding the context of new information and how it fits with extant knowledge – Ability to translate external information into a form understandable by and relevant to internal colleagues – Influential – can convince other network members to take a needed action.
Common Characteristics	– Broad network outside the company – Short to medium organization tenure – Attained higher-level degree in specialized technology field – Genuine interest in keeping abreast of emerging trends in their specialty	– Broad network inside the company – Long organization tenure – Enjoy helping others – Have a reputation for technical competence among their colleagues
How to Facilitate	– Give them time to scan the outside world – Encourage them to attend external networking events – Train them in the effective use of social-media technologies – Use ONA to assess and optimize external network – Include them in talent-management programs and recognize their scouting successes	– Encourage their networking activities through involvement in cross-functional projects and job rotations (particularly for newly employed connectors) – Link them to an idea scout to ensure that the newly identified ideas get disseminated to the right parts of the company – Use ONA to determine if their internal networks contain biases or disconnects – Include them in talent-management programs and recognize their broker role – e.g., make social graphs publicly available

Table 5.1: Innovation Broker Profiles

R&D companies can use our findings to ensure that these competencies exist within their talent pools. In addition, by focusing on the phases of open innovation where idea scouts and connectors contribute most – ideation, selection and diffusion – executives can optimize the contribution of these innovation brokers to the innovation process. Figure 5.2 exemplifies who shines as ideas progress through the innovation funnel.

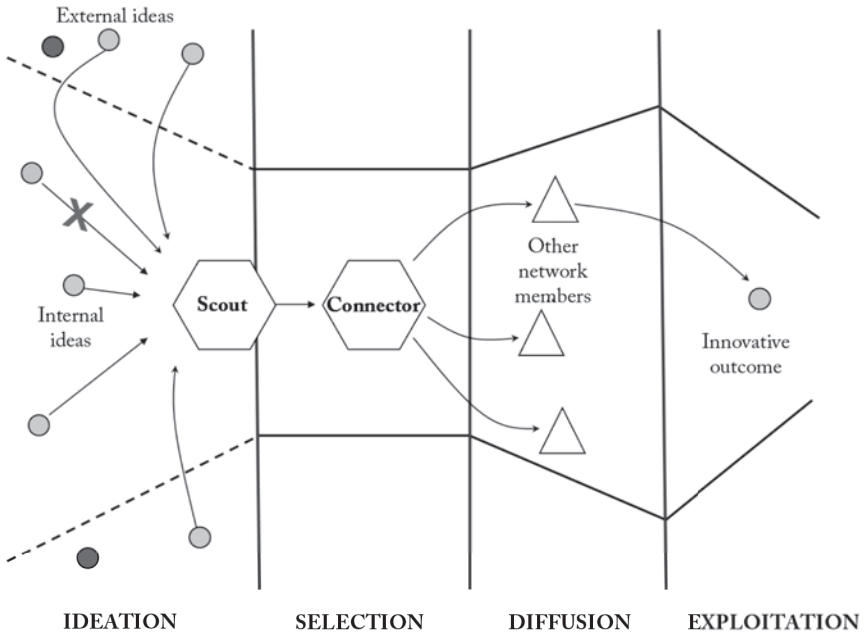

Figure 5.2: Who shines when

5.8 The critical role of innovation brokers in the open innovation process

Ideas from inside and outside the firm progress through four stages until a small number are ultimately exploited in an innovative way. Scouts are more critical in the earlier phases but the emphasis shifts to the connector in the later phases. Scouts identify and discuss promising ideas with connectors. Using their knowledge of the internal network, connectors diffuse and champion the most promising ideas to those who are best equipped to convert them to an innovative outcome.

Ideation

While all employees have the ability to acquire ideas from beyond the company's boundaries, our research shows that there tend to be only a handful of people who possess the technical expertise and personal interest to perform this task regularly and at an effective level. Scouts pick up ideas, carry out a first filtering,

and transfer their input to the next phase in the funnel for further evaluation and development. Management can harness the activities of these idea scouts simply by allocating to them the funds they need to scan the outside world for new knowledge. But we have found that time is the most important resource of the idea scout. For example, one pharmaceutical company we worked with permitted its newly appointed idea scouts to devote 100% of their working week to this activity. In terms of additional resources, all these prospectors need is a computer with an Internet connection. However, it would be beneficial if idea scouts were also given priority to attend external networking events such as conferences or trade shows.

This is not only a way to create alternative channels for ideation; it also allows management to demonstrate its commitment to the front-runner role that these employees play in sparking innovation. While the Web has always been a place where scouts could find emerging content, social media technologies have dramatically expanded scouts' capabilities in this arena. These new social tools – applications such as social bookmarking/tagging, social networking (e.g., Facebook, Twitter), blogs and wikis – enable them to find and follow subject-matter experts and practitioners who have experimented with new ideas and technologies. In effect, scouts using social media perform 'social navigation' – searching for and finding relevant people and content – which is positively correlated with personal innovativeness and success in idea generation (Gray *et al.* 2011). The implication is that organizations need to train current and future scouts on how to most effectively exploit the growing number of social technologies that exist in the business setting; in so doing, they may complement the more traditional channels used to acquire knowledge and ideas from beyond the company's boundaries.

ONA techniques can also help idea scouts probe the outside world more effectively. Each idea scout's explorations can be analyzed to determine if he or she is tapping into the right external networks or if important innovation sources are failing to be leveraged. In the medical-devices company we studied, university labs were an important source of knowledge for its R&D division. An ONA analysis revealed that its idea scouts were indeed connected to university labs, but they tended to be the same three universities from which these workers had graduated. At least 10 university labs globally were conducting state-of-the-art research important to the company, but most of them were not being accessed. To obtain these data, we issued each employee a network-analysis survey, which asked a variety of questions about

their networking activities. While we favored this approach in our work, other more automated methods are also possible. For example, many employees use websites such as LinkedIn to maintain links with their professional contacts. ONA software applications that can convert such online profiles (and even email logs) into a social graph for visual analysis are freely available on the Web. Of course, the employees would have to agree to provide such data for analysis. Including idea scouts in the company's talent-management program is one way to encourage their participation. It must also be remembered that open innovation is not just about outside ideas flowing in. Companies also need to consider collaborating with external partners to liberate internally generated ideas so that they may flow out.

Building external networks through the idea scouts will increase the likelihood of connecting with the outside people and companies best equipped to use the company's own ideas that for one reason or another should be developed elsewhere.

Idea selection

For today's Web-enabled organization, access to new ideas from around the globe is often just a few mouse clicks away. But while the great advantage of the Web is that anyone can publish his or her thoughts on it, this also makes the task of 'separating the wheat from the chaff ' a far more difficult process. In our studies of innovation units, we find that the interaction between idea scout and idea connector is crucial not only for ensuring that the most promising ideas with the best organizational fit are selected for further consideration; the interaction is also crucial for verifying that the outside knowledge is reliable and truly novel – and not just marketing hype, as is often the case. We can think of the idea scout as providing the fuel for innovation and of the idea connector as the engine that converts that fuel into useful outputs. Note that the scout does have a validating or testing role as earlier scouted ideas progress into the organization. Not only to make sure his or her insights are transferred correctly, but also to make sure the scout remains sufficiently in tune with the possibilities, but also constraints, of the organization. Thus, management needs to ensure that scouts and connectors are linked to each other. Google is a company that has excelled in turning nascent ideas into innovative products. Central to this success has been the role of employees such as Marissa Mayer, a company vice president, who exemplifies the key traits of an idea connector. The initial concept for Orkut (Google's social networking site) or for the company's

desktop search did not originate with her, but she played a central role in ensuring that those promising ideas, and many others that bubbled up to the surface, were fast-tracked for investment. One useful mechanism has been Mayer's tradition of holding three weekly sessions where she is accessible to all Google employees who want to pitch a new idea (BusinessWeek 2005). She brainstorms with these scout-equivalents and presses them for more details on the proposed products' functionality before deciding whether to champion the ideas to company leaders Larry Page and Sergey Brin.

The take-away lesson is that organizations need to create formalized means through which idea scouts can reach out to those who have the skills and influence to select ideas with the most merit and feasibility and then to help transform them into innovative products.

Idea diffusion

Once an idea connector recognizes the potential of a new concept, it needs to be diffused to those with the know-how to exploit it. For example, on hearing the initial idea for Google Desktop, Mayer used her knowledge of the internal network to bring it to the attention of Steve Lawrence, a skilled programmer with expertise in information retrieval. Once Lawrence bought into the idea, a team was assembled to work with him to develop what ultimately turned out to be one of Google's most successful products. Idea connectors like Mayer have a natural flair for getting to know others. While they may have been hired initially for their expertise in a particular field, over the years they have evolved into generalists whose knowledge and interests embrace multiple areas. Indeed, connectors' continuous interactions with others contribute to their growing knowledge base, making them even more influential in the innovation process. Thus, connectors need the opportunity and resources to network; involving these individuals in multiple projects throughout the company enables them to build their set of contacts faster and to become more effective dissemination hubs. Job rotation also enables emerging connectors to be exposed to different organizational functions as well as to the business roles, processes and cultures associated with them.

ONA can also be of help to idea connectors by allowing them to grasp if there are parts of the internal network to which their ties do not extend. Knowing of such omissions, they can take the necessary steps to remedy them. And because

ONA graphs may be similarly useful to others in the organization, they can be made intramurally public. In one company we studied, management informed all of the knowledge workers in its marketing and new-product development divisions that ONA graphs would be used for the sole purpose of helping them build awareness and identify key decision makers and subject-matter experts in both divisions. Workers we talked to said they were initially apprehensive about their names being displayed publicly, but many found that the ability to recognize the innovation brokers in the network (both in terms of expertise and number of connections) had helped them to recognize and implement ideas. ONA surveys are now performed regularly at the company as a periodic assessment. In addition, social media collaboration platforms are increasingly providing the ability to view the social graph of any given group. For example, users identify who they are 'following' in the organization, and a map is created and displayed in real time. Again, this gives users the ability to discover others in the organization that potentially have influence in creating and implementing ideas (Krackhardt and Hanson 1993).

5.9 Invest in innovation brokers

Leaders need to recognize that there is far more to open innovation than importing new ideas and technologies into the organization. Promising ideas will not mature into innovative outcomes unless they reach the parts of the employee network that have the expertise and influence to exploit them. While advances in Web-based communication technologies have altered how external knowledge is sourced and distributed, the role of the innovation broker remains as critical as ever. When management invests in the idea scout and the idea connector, and in the relationships between them, it will be well on its way to achieving open innovation success.

ONA: A tool adapted from the social sciences

Organizational network analysis (ONA) is a systematic approach and set of techniques for studying the connections and resource flows between people, teams, departments and even whole organizations. With ONA, social relationships are viewed as nodes and links that can be illustrated visually and mathematically. While the application of ONA to the discipline of management is relatively new, it has enjoyed a long and rich tradition, particularly in the fields of sociology and anthropology. Much of what we know today as ONA is built upon the work of psychotherapist Jacob L. Moreno, who began developing 'sociometry' in the 1930s to reveal the hidden group structures that affect psychological well-being. In management settings, ONA has been effective at providing leaders with insights to help diagnose and solve the problems that often hamper important collective-process outcomes such as organizational structure, decision making, performance and innovation.

Part III

Network Restructuring and the Dimension of Time

Chapter 6

Expanding the Innovation Network: Formal Intervention and Employee Innovative Involvement[15]

6.1 Introduction

To successfully innovate, firms need to generate, grow and implement a sustained flow of ideas (Boeddrich 2004; Katila and Ahuja 2002; Thomke 1997; Van de Ven 1986). As an important driver of the innovative performance of organizations (Blundell *et al.* 1999; Brockhoff 1999b; Capon *et al.* 1990; Chaney and Devinney 1992; Urban and Hauser 1993), this requires an active involvement of employees with innovative activities. The exchange of innovative knowledge that is entailed is most suitably analyzed from the perspective of social network literature (Allen 1977; Burt 1992; Granovetter 1973; Whelan *et al.* 2011). Individuals are known to be more successful at innovation, exchanging new and innovative knowledge, when they have (1) a large number of contacts, or (2) a divers set of contacts to tap into different knowledge bases at their disposal (Rodan 2010; Reagans and McEvily 2003; Burt 1992).

We study how a 'simple formal intervention' by middle management through the establishment of a temporary taskforce enhances individuals' involvement in

[15] This chapter has been submitted as Aalbers, H.L. and Dolfsma, W. (2012). "Formal Intervention and the effects on employee's innovative network characteristics". An earlier version has been presented at the 2012 Organization Science Winter Conference, in Steamboat Colorado (USA) and the 2012 Sunbelt conference, California (USA).

innovative activities through the effect on these two specific network characteristics. Surprisingly, the effect of deliberate intervention by management in general, and to stimulate innovative activities in particular, remains under-explored (Tortoriello 2007; Bartunek *et al.* 2011). We use the term 'simple' to differentiate this type of common taskforce intervention from complex formal intervention arrangements such as heavy weight transformation teams or even reorganization. To identify the effect of such an intervention we study three clearly distinct types of intra-organizational networks; the innovation, the formal and informal network (Allen and Cohen 1969; Allen 1977; Goodwin *et al.* 2008; Ibarra 1993; Madhaven and Grover 1998; Rodan 2010). These three networks are constitutive of organizational life, yet management can often seek to influence only one (the formal network structure) even if its goal is to change another (the innovation network structure).

One reason for this lack of understanding is that network transformation is a complex phenomenon and its measurement and analysis – let alone the challenges of collecting longitudinal network data – pose substantial challenges, both technically and conceptually (Doreian and Stokman 2005). Research on the intervention mechanisms that influence network characteristics over time have thus remained rare (see Balkundi and Kilduff 2005). Given recent calls to better understand human collaboration regarding innovation, we primarily study the effect of the intervention on the innovation network and monitor its relation to the formal and informal networks.

We offer three contributions in our study. Firstly, formal intervention can support the development of the network characteristics commonly found to facilitate involvement in innovative knowledge transfer. Sheer access to others, as well as, separately, access to a diversity of others in the innovation network substantially increases due to a directed formal intervention and, surprisingly, surges in particular among employees that were already somewhat involved in innovative activities but who were not primarily focused on innovation (the so called 'realizers'). Secondly, we find that formal intervention is capable of stimulating newcomers, those employees that had no prior involvement with innovation, to enter into the innovation arena. Thirdly we find that new innovation ties are very likely to be established on a multiplex foundation of combined formal and informal relationships that existed previously. Multiplex intra-organizational relationships are thus of great importance to establish an innovative organizational climate.

This chapter is organized as follows. Section 2 discusses literature about organizations as networks, how characteristics of networks are implicated with innovation activities, and what to expect of an intervention. This section develops propositions concerning how a simple formal taskforce intervention will impact an organization and the involvement in innovation of its employees. Section 3 presents the research context and discusses the data and methods used for the analysis. Results are reported in Section 4, Section 5 discusses and concludes, and Section 6 addresses some limitations of our study.

6.2 Theory and propositions

Organizations may be seen as places in which individuals who have a common purpose and compatible capacities cooperate to reach shared aims (Foss and Lindenberg 2011). An important aim for firms is to be innovative. Firms that successfully innovate show an ability to develop and implement more and better ideas than their competitors, thus gaining competitive advantage (Francis and Bessant 2005). This ability to be innovative relies on social interactions (Bovasso 1996; Reagans and McEvily 2003). Cooperation may be structured formally and informally – the formal and informal networks capture these patterns of cooperation, as is explained below. Exchange of new, innovative knowledge occurs in the conceptually and methodologically distinct innovation network (Rodan 2010).

Organizations as networks

One important aspect about an organization is its formal dimension. The formal aspect of an organization comprises the organizational chart, but also includes quasi-structures such as committees, task forces, teams, and dotted-line relationships that are formally mandated by the firm (Schoonhoven and Jellinek 1990, p.107; Ibarra 1993, p.58). The formal aspects can be defined as "the planned structure for an organization" (Simon 1976, p.147) and focus on relations as formulated by corporate management (Kilduff and Brass 2001). Relationships in quasi-structures tend to be more fluid than relationships represented by the organizational chart, but they are nonetheless mandated by the firm and constitute an important part of the execution of daily operations in the firm (Adler and Borys 1996). The formal dimension of an organization fosters relative transparency and allocates responsibility that may

prevent conflict and can reduce ambiguity (Adler and Borys 1996). In addition, repeated interactions based on routine, day-to-day knowledge helps to build up absorptive capacity at the individual level (Cohen and Levinthal 1990; Matusik and Heeley 2005), and helps in the establishment of a shared understanding based on the exchange of simple knowledge between two parties (Gabarro 1990).

It is impossible to understand processes within the organization without investigating the influence of the informal relations, however (Blau and Scott 1962). The informal network refers to the "interpersonal relationships in the organization that affect decisions within it, but either are omitted from the formal scheme or are not consistent with that scheme" (Simon 1976, p.148). Informal network relations are not mandated, are thus extra-role, but may provide insight into the general way 'things are getting done' within the organization; possibly by-passing and undermining the formal communication structure (Schulz 2003). This informal network is an important basis for the creation of interpersonal trust (Kramer *et al.* 2001; Szulanski *et al.* 2004). When communication via the formal network takes too long, or when the relations required to get certain things done have not been formally established, the informal network ('the grapevines') may come into play as it cuts through the formal structures and function as a 'communication safety net' (Cross *et al.* 2002). The network of informal contacts comprises of those non-mandated contacts that allow individuals to acquire information about what is going on in their organization (Szulanski *et al.* 2004). Norms, values, and beliefs get shared through it (Lazega and Pattison 1999; Schulz 2003). Even though an informal network can be intransparent and a source of resistance to formal change, it can also be a way to transfer new mindsets more easily (Albrecht and Ropp 1984; Hansen 2002).

Next to the formal and the informal organizational networks, this study includes the innovation network. Following Albrecht and Ropp (1984) we define innovation as the development of ideas for the advancement of new products and services and the improvement of existing products and services. The innovation network captures the structure of contacts between employees regarding the exchange of these *new* ideas, innovations and substantial improvements to products and services (Cross and Prusak 2002; Rodan 2010). In contrast to the formal network that measures the ties resulting from exchange of routine, day-to-day knowledge, the innovation network focuses on the transfer of complex knowledge that is not perceived as directly related to the ongoing day-to-day business of the organization

but related to the creation of future competitive advantage. A question that might arise is whether these networks might not conceptually overlap. Aside from the distinct framing in the literature (see Rodan 2010 for a recent overview), we argue that such an overlap is not the case, although the suggestion might be understandable. When interpreting[16] the definition of the innovation network, the formal activities of those employees involved in functional departments most closely align to what might be called innovative departments, such as an organization's New business Development or Research and Development department, are commonly organized based on day-to-day project driven activities, similarly to what is the practice in other departments that have less formal affinity with innovation. Activities are outlined to the employees at these type of departments in their formal work descriptions, project plans and grinded into established work heuristics, just as in any other formally orchestrated working environment. Those activities that might break from the day-to-day routine and pivot around actual new insights and innovative improvements upon existing (concepts) of products or services that are not (yet) formally mandated, are expected to constitute a conceptually different network; the innovation network.

Intervening for innovation

Although the importance of interventions to enhance the working of an organization is often emphasized, and indeed such interventions could be considered the core of what it is that managers do, in particular in relation to knowledge exchange (Dieh and Stroebe 1987; DeChurch and Marks 2006), the exact means by which interventions take effect is not well known (Okhuysen and Bechky 2009, p.482). Exchange of knowledge within a company may, particularly, not occur even when all involved are aware of the need for it (Szulanski 1996). A willingness to share innovative knowledge, especially located in different parts of the organization, should also not be taken for granted (Hansen 1999, p.87; Reagans and McEvily

[16] Interpretation on the distinctiveness of each of the network types was also tested on the NBD population and a random sample of the overall population at Beta Company by means of face-to-face interviews on the appropriateness of the questions and the network differentiation in the context of the company. Each of those interviewed indicated to be intuitively and logically comfortable with the distinction made. The assertion of what innovation meant was further enhanced by the actual intervention that outlined the importance of innovative behavior to the company.

2003; Tortoriello and Krackhardt 2010, p.169). Such exchange may also make positions vulnerable (Ensign 2009). An intervention may be needed for the transfer of innovative knowledge to start or be enhanced.

Exchange of new, innovative knowledge necessarily relies on voluntary, non-mandated behavior of employees, since information asymmetry is implied by definition when one considers new, innovative knowledge. Management may not be aware of the knowledge potentially available to employees in an organization. Employees in turn may not know what knowledge others in the organization have or may need. As a result of this asymmetry the exchange of innovative knowledge can be hampered. Nevertheless, it is well-known that actively and purposively managing the innovation process enhances firm performance (Cooper *et al.* 1999). Because of the asymmetrical distribution of knowledge, the goal of an intervention might be reached indirectly by targeting a different element of an organization. When designing and implementing an intervention to stimulate innovation one is likely to target the formal or perhaps the informal aspects of an organization.

Formal contacts are believed to be more amenable to intervention by management than informal contacts (Beer and Walton 1987). Quasi-structures in particular can be created or dismantled relatively easy. Informal relations are likely to only change over the longer term and are far more difficult to govern by management (Krackhardt and Hanson 1993). One may expect to see the changes in an organization that result from an intervention that is aimed at stimulating innovation to be targeted at and take effect through the formal network structure rather than the informal network structure.

Surprisingly, as formal and purposive interventions are a matter of daily operations at large companies and involve substantial allocation of resources, studies of formal interventions are few and far between (Okhuysen and Bechky 2009, p.482). Little is known about how these interventions actually work, as opposed to how they are planned. Those studies that are available are designed as an experiment under laboratory settings (Henry 1995; Okhuysen 2001). The actual effects of an intervention in a real-life setting are likely to differ from that of an experimental setting (Bovasso 1996; Okhuysen and Bechky 2009). What is more important, the effects of an intervention targeted at one group may also affect other individuals in an organization. Employees who are involved early on in the innovation trajectory will thus be affected by an intervention. We differentiate in our analysis between

'creators', such as employees of a New Business Development unit whose prime area of expertise is innovation, as well as 'realizers', employees who do not have innovation as their primary task but hold a different expertise as their core competence that becomes more relevant as an idea develops and matures (e.g., functional expertise on operations, IT or marketing).[17] Employees who had not been involved with innovation in any way prior to an intervention might be affected as well, however. We refer to this category of employees as 'newcomers' to the innovation arena. Note that these newcomers might be new to the innovation arena, but are not new to the organization per se, already partaking in the formal and informal organizational network. Due to their emergent nature individuals of the latter category typically cannot be involved in a study that adopts a longitudinal experimental design.

Okhuysen and Eisenhardt (2002) found that what they call a 'simple formal intervention' can improve the knowledge sharing process within organizations and is a potentially attractive way to achieve superior knowledge integration (cf. Okhuysen and Waller 2002). In line with Okhuysen and Eisenhardt (2002), a simple formal intervention in an organization is defined as a set of purposively formulated basic instructions and accompanying facilities to engage in specific behavior, executed by a dedicated temporal management taskforce. The formal intervention studied here involved the deployment of a dedicated taskforce to enhance innovation by increasing the relations in the innovation community through awareness creation (cf. Okhuysen and Eisenhardt 2002). An intervention creates a 'window of opportunity' for individuals in an organization to change the way in which they behave or the alters with whom they interact (Henry 1995; Bovasso 1996; Okhuysen 2001; Zellmer-Bruhn 2003). An intervention has a focal group of employees which it targets – in this study the intervention targeted 'early hour innovators' at a company, employees who constitute the innovation community prior to the intervention at t=1. In this study we specifically consider an intervention that aims to stimulate the sharing of innovative knowledge both within and between units. The intervention directly targeted creators and realizors at t=1. This group was identified as the full NBD department (creators) and all their established relations in other functional areas

[17] In line with Song *et al.* (2011) we distinguish between creators whose primary task it is to innovate on the one hand, and realizers for whom innovation is not a primary task but whose expertise may be needed for the development or implementation of innovative ideas.

that were maintained by any of the creators to discuss innovative ideas and concepts (realizers). While seeking to increase overall cooperation in the innovation network, the taskforce operated in a facilitating manner by arranging formal and informal meetings, in effect targeting the formal and informal networks. The taskforce then pitched the relevance of intra-firm collaboration as a kick-off to each meeting, but left further relationship development or campaigning on this topic to the individuals partaking in the meeting. As such a social environment can be designed to encourage constructive exchange (behavior) between members (Robertson *et al.* 1993; Pierce *et al.* 1984).

Effective intervention can cause individuals to shift their focus of attention to others in their environment, and in general stimulates interaction (Okhuysen and Eisenhardt 2002; Zellmer-Bruhn 2003). A simple formal intervention may reduce the barriers that restrict effective knowledge integration, such as lack of familiarity among individuals, distinct thought worlds, disparities in verbal skill, status differences, and physical distance (e.g., Bovasso 1996; Bechky 1999; Dougherty 1992, Eisenhardt 1989; Szulanski 1996). This point of view is supported by social cognitive models of behavior which identify an individual's social environment as an important source of information about appropriate behaviors (Bandura 1986; Porter and Lawler 1968).

People develop routines to behave in specific ways under specific circumstances. Behaving according to routines may lead one to ignore opportunities for initiating relationships with new partners (Cook 1977: 68; Tsai 2000; Gulati 1995). An intervention legitimates certain activities over other activities (Gittell *et al.* 2006), since it directs attention within an organizational setting to particular themes and goals (Ocasio 1997). When the window of opportunity to advance one's patterns of interaction is more apparent, however, the changes to routines may be more likely to occur than when the change sought by the intervention is perceived as less significant. Realizers in particular, defined as those employees that were already somewhat involved in innovative activities but who were not primarily focused on innovation but on another, functional expertise instead (e.g., operations, IT and marketing), have not been primarily involved with the objective the intervention is aiming to further, so the window of opportunity will be more noticeable for them. Those who had already been involved in the activity an intervention seeks to stimulate may not be motivated as much to change their behavior as a result of the

intervention as others who had not been involved. The likelihood that realizers will be more involved with innovation by improving their individual network positions may thus be expected to be larger.

As intra-firm transfer of knowledge is a complex, two-way, iterative process, successfully intervening can be a challenging task. Formal interventions may be poorly communicated and employee involvement may not always be high. Intervention, typically initiated from outside a unit may not be appreciated or understood, as a 'not invented here' attitude might lead employees to resist outside information. Costs of communication with individuals that had not been interacted with before, might be high or perceived as high (Reagans and McEvily 2003). Insufficient resources may be made available to facilitate such exchange (Malik 2002; Szulanski 1996). There might then be more opportunity for structural improvement in the innovation network for realizers. They are likely to be upfront less involved in the costly cross-unit exchange that is required for innovation prior to the intervention. The overall communication costs they face before the intervention are lower, leaving relatively more opportunity to add new contacts (Levine and Prietula 2011; Haas and Hansen 2005; Tsai 2000). In addition, even when involved in cross-unit exchange, what is exchanged is more likely to be of an explicit nature, which would result in lower costs of exchange (Hansen 1999; Reagans and McEvily 2003).

Okhuysen and Eisenhardt (2002) find that the positive effects of enhanced contacts are mostly to be expected when the intervention is not perceived as threatening (cf. Shah 2000). Hence it is essential that employees can see that sharing leads to immediate gains such as less hassle, or easier tasks, reduced working hours or earlier closing (McLaughlin *et al.* 2008). A threatening intervention will result in 'self-focus' rather than a focus on others in the group or outside of the group (Shah 2000). Realizers may find the intervention less threatening, since it is challenging them to do more or better at what to them is a non-core task. The intervention may not be perceived as an implicit criticism of their previous involvement. The formal intervention leads to a broadening of their functional scope through the emphasis that is put on the innovation theme.

Network characteristics for innovative involvement

Innovation involves cooperation and relies strongly on social interactions (Bovasso 1996), and is driven by both the sheer number of contacts as well as by

the diversity of contacts available to an individual as gateways to new and original insights (Tsai 2002; Perry-Smith and Shalley 2003; Burt 2004). An intervention to stimulate the involvement in innovation may target employees that professionally are already involved in the innovation trajectory (creators and realizers) as well as newcomers. From a number of studies looking at innovation within a firm, focusing on the networks involved, it is well known what characteristics of networks will enhance innovativeness (Bjork and Magnusson 2009; Ibarra 1993; Dougherty 1992; Albrecht and Hall 1991). Number of contacts as well as diversity of contacts are prime among these characteristics. A simple formal intervention will take effect through these characteristics of an individual's network position.

Number of contacts

By communicating with others, individuals gain access to novel perspectives and unique knowledge and can generate political support for their ideas. A 'law of large numbers' applies in the context of idea generation: the larger the number of sources of ideas available to an individual, the likelier one is to encounter, combine and further develop new ideas (Ohly *et al.* 2010). The sheer number of ties an individual maintains relates to the ability to generate new ideas (Burt 2004; Bjork and Magnusson 2009; Ohly *et al.* 2010). The number of contacts an individual holds also helps in evaluating ideas according to the standards valid in a larger social context (Binnewies *et al.* 2007; Leenders *et al.* 2003; Ohly *et al.* 2010). Related to this, the absolute number of relations an individual maintains correlates with the proportion of high-quality innovation ideas generated by an individual (Bjork and Magnusson 2009). A large number of contacts enhances creativity and innovation because well connected actors tend to trust each other more, are more willing to share their knowledge and ideas openly, and are well equipped to validate input received (Perry-Smith and Shaley 2003). More internal communication will enhance a firm's innovative performance (Foss *et al.* 2011).

Diversity in contacts

Diverse contacts with others provides access to diverse experiences, unique and varied resources, and alternative thought worlds (Cross and Cummings 2004; Hustad and Teichland 2005; Mors 2010; Reagans and McEvily 2003). Holding cross-unit contacts increases one's access to alternative views on a firm's existing strategy,

goals, interests, time horizon, core values and emotional tone and complementary functional expertise (Ancona and Caldwell 1992; Cummings 2004, Mors 2010; Burt 1992, 2004; Floyd and Lane 2000). Although there are also obvious difficulties associated with transferring, integrating, and leveraging the heterogeneous inputs and diverging perspectives available across intra-organizational boundaries (Argote 1999; Carlile 2004; Dougherty 1992; Tortoriello and Krackhardt 2010), the diversity of insights can benefit the innovative knowledge base and performance of individuals and sharpen the quality and robustness of new ideas (Mors 2010; Carlile and Rebentisc 2003; Hansen 1999; Tsai 2001). Low density or non-redundant intra-organizational networks will allow one to combine different ideas to create new ones (Burt 1992, 2004). In a low density or sparse network actors are likely to receive a greater diversity of information as they relate to diverse others (Burt 2004; Mizruchi *et al.* 2001; Perry-Smith *et al.* 2003). Besides bringing in their own specialized expertise and representing the interest of their own specific unit, individuals who hold diverse, cross-unit contacts also have to think and act outside the perhaps more narrow confines of what their own job and position require (Duncan 1976; Floyd and Lane 2000; Foss *et al.* 2011). Exposure to conflict and discussion as a result of different needs, objectives and interests between differentiated organizational units and hierarchical levels is also believed to increase innovative outcomes at the individual level and sharpen the quality and robustness of ideas (Duncan 1976; Mom *et al.* 2009). When shared within the unit an individual operates in, the diversity of insights and knowledge can contribute to the unit's knowledge base and enhance performance.

An intervention to stimulate involvement in innovation activities is expected, to summarize, to lead to increases in the number and diversity of contacts maintained. Among the early hour innovators, *creators* as well *realizers*, it is in particular this latter category of individuals that is expected to increase their involvement in the exchange of *new* ideas, innovations and improvements to products and services (Brettel *et al.* 2011; Olson *et al.* 2001). Realizers may be more likely to become further involved with innovation by increasing the sheer number as well as the diversity of innovation contacts as a result of a simple formal intervention to stimulate innovation. Creators in a company, more heavily involved in innovation even before the intervention, have already established contacts that cater to this objective. For them the window of opportunity may be less apparent. The network of contacts that creators maintain

already is more likely to be crossing unit boundaries to begin with and is more likely to involve the exchange of complex or tacit knowledge, both of which increase the costs of communication. Realizers, not primarily involved in innovation activities but stronger focused on the 'going-ons' in the formal and informal networks, are less likely to have a mature innovation network available to them prior to intervention. Realizers may find it less threatening to become more involved in innovation, and are far less constrained by communication costs faced before the interventions. We thus suggest the following propositions:

> ***Proposition 1:*** *A simple formal intervention will increase the sheer number of ties in the innovation network available to early hour innovators, and in particular to realizers.*
> ***Proposition 2:*** *A simple formal intervention will increase the number of cross-unit ties in the innovation network available to early hour innovators, and in particular to realizers.*

Ripple effects (newly involved individuals)

Although targeted at the established innovation community at t=1 (creators and realizers), the intervention may increase involvement with innovation by all employees, and so when only observing the effects on individuals who had been involved with innovation prior to the intervention the full effects from the intervention may only be partially visible. Reasons to expect 'newcomers' to become involved in the innovation network due to the intervention reflect expectations about realizers to expand their involvement more than creators would as a result of a simple formal intervention.

Prior research has indicated that intervention is an interruption of common procedure, creating a window of opportunity for people to reconsider and possibly change or add to their normal activities (Tyre and Orlikowski 1994; Okhuysen and Eisenhardt 2002). Individuals are more likely to become aware of other activities, and in particular those activities endorsed by the intervention as deserving with enhanced legitimacy (Tyre and Orlikowski 1994; Ahuja and Katila 2004). This may stimulate the reevaluation of the way things have been going beyond just by the individuals targeted directly by the intervention. As a result of this 'window of opportunity', we expect the effect of the intervention to transcend beyond the early

hour innovation community at t=1. Employees who did not belong to the initial innovation community at time of the intervention will be drawn in.

The effects of a simple formal intervention to stimulate involvement with innovation may create ripple effects throughout the organization as members of the target community interact with others in the organization. These others may learn independently of the potential benefits to be gained as well, however, since information may take different routes to spread in a network (Newman 2001). Boundaries to be involved with the innovation community, perceived or real, have lowered due to the intervention. The legitimacy of activities undertaken in the innovation network has increased, and the activities by early hour innovators reaching out will be reciprocated by newcomers (Bouty 2000; Dolfsma *et al.* 2009). Newcomers may be less likely to perceive the intervention as an implicit criticism of their activities prior to the intervention. Moreover opportunistic behavior by newcomers may be involved as they seek to benefit from being involved in an expanding community participating in an activity that is valued in the organization (Bovasso 1996; Burt 1992). Aside from the expected opportunistic behavior triggered by the potential disclosure of new resources, a newcomer's desire to position oneself quickly as part of a new social environment may also contribute to the ripple effects of a simple formal intervention as participation may reduce an individual's cognitive social strains (Levine *et al.* 2001). As newcomers are not faced with running social investments towards becoming involved in the innovation network, they face the lowest threshold in terms of sunk costs of each of the three employee types studied. To conclude, also new members may thus become aware of the purpose of the intervention and might realize the individual gain that is to be had. They might alter their behavior to join the innovation community where relatively complex, innovative knowledge is exchanged (Bovasso 1996, p.1419). Hence we propose the following:

> ***Proposition 3:*** *A simple formal intervention will increase the total number and diversity of ties involved in innovative knowledge transfer through the inclusion of 'newcomers'.*

Multiplexity and innovation involvement

A simple formal intervention may have unintended consequences (Okhuysen and Eisenhardt 2002). Proposition 3 suggests that these may be positive in that they

contribute to the involvement even of newcomers into the innovation network. In addition, among early hour innovators innovation relations may emerge that did not exist before. What then may be asked is: between whom will new relations in the innovation network emerge?

Organizations are complex systems in which different networks may be discerned (Borgatti and Halgin 2011). People, however, have a tendency to combine different possible aspects to a relation into a single tie with a concrete alter (McPherson *et al.* 2001). Combining different possible dimensions of a relation into a single tie between two people is known as multiplexity (Ibarra 1993, 1995; Coleman 1988), and has been shown, in different contexts, to produce beneficial results to the individual and to his social environment such as a firm (Ibarra 1995; Burt 1984; Coleman 1988; Smith-Doerr *et al.* 2004; Minor 1983; Rogers and Kincaid 1981; Roberts and OReilly 1979). Multiplexity has also been linked to innovative performance (Albrecht and Hall 1991; Cross *et al.* 2001). Earlier studies found employees more likely to talk about new ideas with those colleagues with whom they also discuss work and personal matters (Albrecht and Ropp 1984; McAllister 1995). These same studies showed that innovative relationships typically benefit from the increased perception of personal security and reduced uncertainty that comes with relationships held in other context. As an intervention will commonly be directed to the formal, and possibly to the informal network within an organization, an exploration of the multiplex relationship between formal, informal and innovation ties is germane.[18]

Formal ties may play a key role in the development of the innovation network and so may be the prior tie to base a new innovation tie on. The repeated interactions common in routine, day-to-day formal networks build absorptive capacity at the individual level (Cohen and Levinthal 1990; Matusik and Heeley 2005). Exchanging non-complex knowledge between two parties also helps to build a shared understanding among employees (Gabarro 1990). Absorptive capacity at the dyadic level may in turn facilitate transfer of more complex, innovative knowledge between those two parties (Lane and Lubatkin 1998; Matusik and Heeley 2005).

[18] A tie in the innovation network could conceivably exist without a concomitant tie in another network even though in our study we do not find any such instances.

Alternatively, Albrecht and Ropp (1984) suggest that employees tend to discuss new innovative ideas first with colleagues with whom they have established an informal tie before. Informal ties formed in the past can thus be a basis for newly established innovation ties because of the interpersonal trust that has emerged in informal contacts (Hansen 2002; Kramer *et al.* 2001; Szulanski *et al.* 2004).

Involvement in the activity of innovative knowledge transfer is largely discretionary or extra-role, even more so than involvement in the informal network. It may be unknown in advance what relevant input for innovative activities are, and it may be uncertain what will result from innovative efforts. What input has contributed to the innovation can be unclear. Innovative knowledge is asymmetrically distributed between those intervening and those who are subject to the intervention, as well as among the latter (Szulanski 1996; Okhuysen and Eisenhardt 2002). Agents may not be aware of the others' needs for certain knowledge. Such barriers may be reduced if and when one knows one another from different contexts – if one has a multiplex tie with alters.

Newly established ties in the innovation network can then be expected to be based on previously existing ties that combined formal as well as informal aspects already. Establishing new relations in the innovation network, either by individuals already previously involved in this network or by individuals newly involved in this network, are expected to build on the multiplex combination of informal *and* formal contacts that were available before the intervention at t=1. When individuals are connected in a number of different ways, more as well as better information tends to be exchanged (Sias and Cahill 1998). A relation of one kind keeps in check the negative side-effects of a relation of a different kind (Marsden 1981). In addition, people may be in a better position to determine and interpret how someone will behave in one context if her behavior and attitude is known from a different context. As relationships come to include multiple aspects they are characterized as more intimate, supportive and durable and thus uncertainty can be reduced and trust may grow (McAllister 1995). Still, even though a multiplex foundation is existent, elevating such a relation to one that also includes an innovative dimension is not evident per se. It might very well be that such a social infrastructure is present for some time, without being utilized at all, making the potential of dormant nature. Although in many cases rather evident, or maybe opportunistic, to also include innovation in one's relational repertoire, one might still need somewhat of an

incentive to take the final hurdle. Also here we argue that an intervention might create that 'window of opportunity' to further one's interaction pattern by adding an extra innovation dimension, by labeling it as a legitimized goal to spend one's corporate hours on (Henry 1995; Bovasso 1996; Okhuysen 2001; Zellmer-Bruhn 2003; Gittell *et al.* 2006). Given the benefits attributed to a multiplex relationship as stated above over uniplex relationships, attempts to take this same hurdle when departing from a uniplex foundation (either formal or informal only) might prove too much of a barrier, when attempting to spark the required innovative atmosphere. We thus expect a new innovation tie, formed because of the intervention, to be based on a previously existing multiplex tie combining formal and informal aspects as a means to ease innovative knowledge transfer between individuals and contexts.

> ***Proposition 4:*** *The creation of new ties in the innovation network by an individual at t=2 that result from an intervention, are likely to be based on corresponding ties in both the informal and formal network (multiplex ties) established prior to t=2 by that same individual.*

6.3 Research setting, data and methods

The case study – Beta Company

This study was carried out at Beta Company, one of Europe's largest and most innovative payment processors, leading the market for payments and card processing solutions. With an annual processing volume of almost 7 billion payments and the switching of 1.9 billion POS and ATM transactions, the company's market share within the Eurozone is well over 10%. The company employs 1500 employees. Observation at Beta Company began during May 2009, coinciding with the first measurement round of network data.

We observed the innovation community prior to, during and after the intervention of the establishment of Taskforce Y, gathering evidence on the effect of this formal intervention on the social structure of the organization. The formal intervention involved the deployment of a dedicated taskforce to enhance innovation by increasing the relations in the innovation community through awareness creation (cf. Okhuysen and Eisenhardt 2002). The focus of the intervention was to enhance the innovation involvement of the established, early hour innovation community, at t=1.

While seeking to increase cooperation in the innovation network, the intervention operated in an indirect manner by arranging formal and informal meetings, in effect targeting the formal and informal networks.

Data collection

Through a repeated network survey and semi-structured interviews we collected the required data over time. Interviews served three purposes: first, to become familiar with the organization and, second, to serve as the first round in our snowball sampling procedure and, third, to place our quantitative findings in the appropriate qualitative context.

Network survey

The network survey employed a snowball sampling procedure. Snowball sampling is commonly deployed in network analysis studies and is especially useful when the target population is not clear from the beginning or when it may cut across unit boundaries (Wasserman and Faust 1994). We measured the formal (workflow) network by asking respondents with whom they interacted to successfully carry out their daily activities within the organization that were prescribed or mandated by the organization (Mehra et al. 2001; see also Brass 1984; Brass and Burkhardt 1992; Cross and Cummings 2004; Whitbread *et al*. 2011). The explicit focus is on existing products and services that have already been developed, or relations that had already been established and follow from the respondent's role or position in the organization. Following Ibarra (1993) and Brass (1984) we measured the informal network by asking respondents with whom they discussed what is going on within the organization to get things done that are of personal relevance to them (cf. Mehra *et al*. 2001; Smith-Doerr *et al*. 2004), allowing us to capture the 'organizational grapevine'. This informal network provides insight into the general way 'things are getting done' within the organization (Umphress et al. 2003), often by-passing the formal communication structure (Schulz 2003). The innovation network was measured by asking respondents to score with whom they exchanged new ideas, innovations and substantial improvements to products and services that are not part of their day-to-day activities (Rodan 2010; Stephenson 2006; Cross and Prusak 2002, p.107). Whereas the name generator question for the formal network measures the connections resulting from exchange of routine issues and day-to-day information,

the name generator question for the innovative knowledge transfer network asks about the transfer of new or complex knowledge that was specifically not perceived as related to the ongoing business of the organization (Rodan 2010). For all measures recollection of contacts over a period of the previous three months was requested for.

The target population emerged in several rounds of surveying, where contacts mentioned in a round determine who should be approached as a respondent in a subsequent round. To exclude the risk of ignoring 'isolates' who do possess relevant knowledge to a particular subject but who are not well connected, we targeted respondents with differing backgrounds in our first round (Rogers and Kincaid 1981). The boundary of the population was identified by focusing on the radical innovation activities of the company. The development of these activities is positioned under the responsibility of the New Business Development unit (NBD) which was selected as the focal group where snowball sampling started.

The snowball sampling procedure was applied at t=1 and t=2. At t=1 this resulted in the identification of 181 individuals. For the first round, all 27 employees involved in the NBD unit, those most deeply entrenched in the innovation community, were approached and all filled in the questionnaire. To reduce ambiguity, network questions were formulated in the native language – in this case Dutch and English. We did not set a maximum number of contacts respondents could enter as that could unduly affect network structure (Friedman and Podolny 1993; Huang and Tuasig 1990). This generated new names involved in any of the 3 networks under investigation (formal, informal, innovation). This selection of names was validated by the manager of the NBD unit as well as by the head of the other units involved in radical innovation activity. The second round of targeted respondents received the survey by email and/or answered questions as framed in our survey during face-to-face interviews in case they did not respond initially. Our overall response rate at t=1 was 95% percent. Based on a similar procedure our overall response rate at t=2 was 92% (241 individuals in the innovation community).

Qualitative data collection

In addition to the organizational network measures, data were gathered by accompanying taskforce management as they went about their daily routines. Data on the non-relational and relational elements of the taskforce were assembled by noting the activities of the taskforce members, by interviewing the members and by

having taskforce members write up the activities and their perception of the effect of the intervention. Conversations were written in shorthand devised for the purpose of documenting setting-specific argots. Observations of actions and interactions were supplemented by data drawn from the interviews and questionnaire and from company records.

Variables

Propositions 1 and 2 label 'increase in number of ties', and 'increase in number of cross-unit ties' as independent variables for the group that the simple formal intervention was targeted at: realizers and creators. Proposition 3 examines the possibility of newcomers becoming involved in innovation activities by establishing new and potentially diverse ties and cross-unit ties in the innovation network. These newcomers to the innovation arena had not been included in the innovation network at t=1. The evidence for our intermediate proposition 3 is thus necessarily of a qualitative nature. For proposition 4, emergence of newly established ties in the innovation network is named as the dependent variable. To process and analyze the network data we use Ucinet 6 (Borgatti *et al.* 2002).

Number of contacts

Following Freeman (1979) and Tsai (2001), we use in-degree centrality as a measure for sheer number of contacts since it is the most suitable measure to capture an actor's access to information or knowledge. Bjork and Magnusson (2009) point out that in-degree centrality is the most appropriate measure in the context of early stage idea generation. In-degree centrality is a stable (Costenbader and Valente 2003) and reliable measure since it does not rely on self-reporting (Casciaro 1998; Carley and Krackhardt 1996). An actor's in-degree centrality is measured as the number of times ego is mentioned by alters in a specific network. We calculated in-degree centrality pre- and post-intervention.

Diversity of contacts

Diversity of contacts is commonly measured by means of the number of bridging ties (Burt 1992; Hansen 1999; Perry-Smith 2006). Bridging ties are ties that span across unit-boundaries and hence are referred to as cross-unit ties. The

number of cross-unit ties before and after the intervention were determined to allow for the analysis of potential longitudinal effects.

Simple formal intervention

Since involvement in innovation is highly discretionary and extra-role, directly intervening in the innovation network is not likely to be feasible. The formal intervention consisted of a taskforce run for a period of two months and was staffed by a senior and a mid-level employee, both of whom could allocate the majority of their time to implementing the intervention. Each of the task force members was well connected throughout the organization. The intervention directly focused on all employees that constituted the innovation community at t=1 (creators and realizers) by means of bilateral and team meetings to emphasize the relevance of enhanced cooperative behavior for both the innovation community as a whole as for the individual. The taskforce contacted creators and realizers at t=1 to explain the purpose of the intervention and the activities to be undertaken. The taskforce, for instance, offered to introduce individuals to others within the organization.

Controls

Three variables were included as controls: *tenure* (in months), *gender* and *hierarchical level* per individual employee. We included tenure to control for the amount of time an individual has had to develop relations throughout the years (Gundry 1993). Gender and hierarchical level were added to control for group affiliation effects. In addition, we controlled for value of ideas offered as reported by receiver to have a measure for what was actually exchanged (Ensign 2009).

6.4 Results

The innovation community at Beta Company increased in size (Table 6.1) and became increasingly active (Table 6.4 and Figure 6.1) due to the intervention. One could also claim, as a creator did at t=1, that there was a dire need for improvement: *"involvement with innovation is poor, we are truly wasting potential. Communication between NBD and the rest of the organization is at a low."*. Taking into account the effect of organizational attrition, 139 individuals were eventually involved in innovation at both t=1 and t=2. For this full group of 139 individuals, activity in the

innovation network can be statistically compared over time to assess the effects of the intervention in relation to what propositions 1 and 2 predict.

Number of actors in the innovation network	**t=1**	**Actor attrition**	**t=2**
Creators (member of innovation network at t=1 and t=2)	27	2 left the company	25
Realizers (member of innovation network at t=1 and t=2)	117	3 left the company	114
Newcomers (member of innovation network since t=2 only)	x		102*
Total	**144**		**241**

Table 6.1: Innovation network over time

** All newcomers are realizers; no additional creators emerged / were hired between t=1 and t=2.*

Intervention's effect on number and diversity of ties

The intervention targeted the full innovation community at t=1. We differentiated this population in two distinct groups, those affiliated with the NBD unit (*creators*) and those affiliated with unit that did not have innovation as prime objective (*realizers*) to test for the anticipated differences between both. Difference in difference (D-in-D) estimation was used to assess the effects of the intervention on the outcome variables of involvement in innovation. We controlled for tenure, gender and hierarchical level for reasons well-documented in the literature (Dolfsma and Van der Eijk 2011). In addition, we controlled for value of ideas offered as reported by receiver to have a measure for what was actually exchanged (*ibid.*). The D-in-D estimate is the delta of number of ties based on in-degree centrality and cross unit ties. These are our dependent variables and are referred to in our regression models as 'delta (Δ)'. They are calculated for the 139 employees involved in the innovation network at both t=1 and t=2. No delta can be calculated for newcomers. Table 6.2 first presents descriptives.

#	Variable (actor level)	Mean	Std. Dev.	1	2	3	4	5	6	7	8
1	Gender	.7913	.40815								
2	Value of input	5.187	.498	.102							
3	Tenure	8.706	6.324	.069	.009						
4	Hierarchical level	4.43	.877	-.072	-.162	-.103					
5	# Cross-Ties (t=1)	1.81	3.434	-.067	-.095	-.261**	.147				
6	# Ties (t=1)	2.65	4.538	-.051	-.060	-.240**	.080	.791**			
7	# Ties (Δ t1to 2)	.0870	3.817	.009	.086	.189*	-.193*	-.801**	-.473**		
8	# Cross-Ties (Δ t1to t2)	1.104	3.525	.163	.075	.106	-.153	-.297**	-.159	.505**	
9	Creator (y/n)	.1942	.39705	.000	-.055	-.268**	.174	.689**	.738**	-.600**	-.146

Table 6.2: Means, standard deviations, and correlations; t=1 and t=2.
****, ** and * indicate correlation at significance level of 0.1%, 1% and 5% respectively, N=139).*

Prior to conducting the regressions, variables were examined for homoscedasticity and for non-normal distributions. The outcomes showed no violation of the normality assumption. Table 6.3 presents the results for each of the linear regression models that test for propositions 1 and 2[19].

[19] In social networks observations are, by definition, not independent. This violates an important assumption that underlies most standard statistical techniques. However, although we know that the independence assumption is violated in social network data, it is generally unknown to what extent this affects parameter estimation and inferences. Over the recent years, advances have been made in the development of statistical analysis techniques well-suited for social network data (most notably ERG-models, Siena, p-star, and QAP), but none of these models are suited for the testing of the specific hypotheses in this chapter. We therefore decided to present results based on the OLS-framework in this chapter, because it allows one to present readily interpretable results. Statistical theory suggests that the parameter estimates in the OLS model are likely to have little bias. The lack of independence of our observations is, however, likely to affect the width of confidence intervals and, as a result, may make inference based on OLS models lack in conservatism. To address this OLS shortcoming, we conducted a bootstrap procedure (Snijders and Borgatti, 1999; Davison and Hinkley, 1997; Efron, 1979; Efron and Tibshirani 1986) to estimate empirical confidence intervals, both parametrically and nonparametrically. In particular, we conducted an m-out-of-n bootstrap (Bickel and Ren 1996; Bickel, Goetze and Zwet 1997), based on 10000 resamples, each with a size of 50 percent of the original sample drawn with replacement. The m-out-of-n approach was chosen because it strongly reduces potential dependence effects in the data. Unfortunately, the m-out-of-n approach does tend to make confidence intervals somewhat wider and, consequently, p-values more conservative than necessary. This can be considered

D.V.:	**Number of Ties** (Δ t1to t2)		D.V.:	**Diversity: Cross-Unit Ties** (Δ t1to t2)	
	Model 1a	**Model 1b**		**Model 2a**	**Model 2b**
Gender	-0.054	-0.029	Gender	-0.075	-0.043
Value of input	-0.031	-0.024	Value of input	0.011	0.018
Tenure	0.030	-0.006	Tenure	0.040	0.003
Hierarch. level	-0.155**	-0.124	Hierarch. level	-0.093	-0.072
# Cross-Ties (t=1)	-0.290***	0.014	# Ties (t=1)	-0.584***	-0.361***
Creator (y/n)		-0.435***	Creator (y/n)		-0.344***
N	139	139	N	139	139
F-value	3.113**	4.848***	F-value	13.190***	14.083***
R^2	.125	.212	R^2	.377	.439
Adjusted R^2	.085	.168	Adjusted R^2	.348	.408
F-test for incremental R^2		11.958***	F-test for incremental R^2		11.933***

Table 6.3: Effects of intervention on number and diversity of ties

*[a] All independent variables are standardized; ***, ** and * indicates a significance level of 0.1%, 1% and 5% respectively; [b] Type of employee: yes = creator, no = realizer; [c] None of the variables listed were found to have tolerance levels <0.45 or VIF values >2.4*

Number of ties

Table 6.4 shows a substantial increase in the number of ties due to the intervention. Models 1 in Table 6.3 show that the increase is particularly due to the realizers becoming more involved with innovation (b=-0.435, p<0.001). Although creators also become more involved as shown by the absolute amount of ties for both periods in Table 6.4, they do so at a lower growth rate than realizers. Adding additional ties at t=2 might be more difficult in particular for an individual who had a larger number of ties to maintain at t=1. Additionally, the significance of the control variable 'number of cross unit ties at t=1' found in the base model 1a (b=-0.290, p<0.001) completely disappears in our focal model 1b. Having a diversity of cross-

a drawback, but it also suggests that any statistically significant result that "survives" the m-out-of-n bootstrap has to be a strong and valid effect. The fact that most of our substantively relevant findings stood up to this bootstrap approach, suggests that these effects are pervasive and are unlikely due to the lack of observation independence in our data.

unit ties does not prevent one from adding ties upon an intervention. Variance explained increases as well. Qualitative data confirms this finding. As one realizer stated: "*I appreciate the increased buzz surrounding the topic of innovation. And honestly it is the enthusiasm of my colleagues that made me realize that there are things to be gained here, even though I am not directly responsible for innovative output, that is.*"

Our findings thus support proposition 1.

Cross-unit ties (diversity)

Table 6.4 shows that as a result of the intervention the number of cross-unit ties increased substantially as well. A manager (realizer) claimed: "*Communication regarding new ideas and services is exceedingly slow and centered around elite groups. What should be improved is discussed and developed by an in-crowd. Choices concerning innovation are made without involving relevant outsiders.*" Models 2 in Table 6.3 indicate that realizers again show a stronger increase in the number of diverse cross-unit ties from t=1 to t=2 as compared to creators (beta=-0.344, $p<0.001$). As developing new cross-unit ties might be more difficult when one has a large number of ties to begin with, we have included the number of ties at t=1 as a control variable. There indeed seems to be such difficulty: the significant negative effect for total number of ties maintained at t=1 preventing one from establishing a cross-unit tie in model 2a (b=-0.584, $p<0.001$) remains in the full model 2b (b=-0.361, $p<0.001$). None of the control variables, noticeably, have a statistically significant effect in the models in Table 6.3.

These findings support proposition 2.

Newcomers

Proposition 3 predicts that the simple formal intervention will affect others outside the initial innovation community too. The proposition suggests that at t=2 newcomers will be involved in innovation due to what may be called a ripple effect that results from the formal intervention. As at t=1 it logically was unknown who might be involved in innovation activities after the intervention at t=2, no longitudinal data could be collected on newcomers, confining longitudinal statistical analysis. Analysis of descriptive and qualitative data provides a valuable substitute however. Descriptives in Table 6.4 show increases for both the number of ties and the number of cross-unit ties following the intervention. This increase for creators and realizers combined is

lower than for the newcomers (146 and 149 respectively for number of ties; 53 and 61 respectively for cross-unit ties). Already at t=2, not too long after the intervention that was not targeted at them specifically, newcomers had developed a substantial involvement in innovation. Even though the bulk of the innovation activity is still carried by creators, while the realizers have stepped up quite substantially, newcomers to the innovation network show an average involvement at t=2 that is comparable to the realizers at t=1 despite the fact that realizers involved at t=1 already have had much longer to become involved in innovation activities. A newcomer illustrates this clearly when he stated*: "I got involved with the innovation community as the result of interesting conversation with my old mentor who introduced me to this group that had gathered around a new technology that is closely aligned to my prior experience. I actually was unaware of them running these activities on-the-side."* More people throughout the organization experienced the increased importance attached to or urgency of transfer of innovative knowledge. In a number of interviews this became apparent. Also as in formal meetings not primarily focused on the topic, innovative collaboration is scheduled as an item for discussion, however. One newcomer expressed it clearly: *"If the key players within our organization, and then I do not only mean management but also those of my colleagues that have been around here for a while, think our involvement with innovation is important, it must be."* Employees who have been hired recently sense the change in atmosphere, and also a change in the extent to which cross-unit exchange is stimulated and actually occurs, most strikingly. Creators maintain both more ties as well as cross-unit ties on average than realizers or newcomers. Given that the NBD unit is relatively small and it is the prerogative of creators working there to be involved in cross-unit ties, one would expect this. Nevertheless, realizers and particularly newcomers are able to become involved even as a result of a small intervention that has had to target the formal and informal network structures rather than the innovation network immediately.

Qualitative data in combination with indications from the descriptive data suggests support for proposition 3.

Employee typology	Innovation ties: number (average)		Cross-unit innovation ties: number (average)	
Time period:	**t=1**	**t=2**	**t=1**	**t=2**
Creators (member of innovation network at t=1 and t=2)	241 (8.93)	257 (10.28)	188 (6.96)	183 (7.32)
Realizers (member of innovation network at t=1 and t=2)	141 (1.21)	271 (2.38)	72 (0.62)	130 (1.14)
Newcomers (member of innovation network since t=2 only)	n.a.	149 (1.46)	n.a.	61 (0.60)
Total	**382 (2.65)**	**677 (2.81)**	**260 (1.81)**	**374 (1.55)**

Table 6.4: Ties in the innovation network, t=1 and t=2

Multiplexity as a basis for innovative ties

Proposition 4 suggest that the creation of new ties in the innovation network by an individual (creators, realizers, as well as newcomers) are likely to be based on multiplex ties combining formal and informal aspects of a relation. Table 6.5 indicates that multiplex ties indeed are quite frequent, in line with what other studies have found (Gulati and Puranam 2009; Smith-Doerr *et al.* 2004). QAP regressions for t=1 and t=2 separately (Table 6.6) indicate that the multiplexity phenomenon, at the level of analysis of the network, remains important when moving from t=1 to t=2. The existence of ties in the innovation network correlates with multiplex ties and seems to be explained by their concomitant existence.

Tie type	t=1	t=2
Formal-only ties	66	80
Informal-only ties	36	53
Multiplex ties (combining formal and informal)	379	598
Innovation ties	382	677

Table 6.5: Tie frequency by network type, t=1 and t=2

The results in Table 6.6 show that the formal and the informal networks separately help explain innovation activity in the innovation network (models I and II). Also when including both these networks in model III, these networks are found to have predictive power. In model IV we separate the multiplex ties from the formal-only and informal-only ties and combine them into a new, distinct set of multiplex ties. Recoding of ties into formal-only, informal-only, and multiplex ties does not change the information content used for the model. Model IV shows that in particular multiplex ties combine activities in the innovation network. Betas for the formal-only and informal-only tie variable decrease quite substantially. There is thus a degree of coherence between the three networks that is conducive to innovation activities that remained over time even when the networks grew substantially in size, due to the intervention, from t=1 to t=2.

	Model-I		**Model-II**		**Model-III**		**Model-IV (‡)**	
	t=1	**t=2**	**t=1**	**t=2**	**t=1**	**t=2**	**t=1**	**t=2**
Inform. network	0.803***	0.717***	–	–	0.329***	0.369***	0.215***	0.069***
Formal network	–	–	0.844 ***	0.747***	0.572***	0.444***	0.155***	0.253***
Multipl. network	–	–	–	–	–	–	0.836***	0.741***
R^2 (adj.) (t=1)	**0.644**		**0.73**		**0.747**		**0.768**	
R^2 (adj.) (t=2)		**0.614**		**0.658**		**0.618**		**0.615**

Table 6.6: Formal, informal, multiplex, as well as innovation ties, t=1 and t=2

*QAP regressions using UCINET (Borgatti et al. 2002), controlling for tie strength; 5000 permutations. Coefficients standardized. ***1% significance. (‡) Formal-only and Informal-only networks* ***net of*** *multiplex relations.*

Coherence between the three networks does not necessarily mean that the 295 newly established ties in the innovation network following the intervention have indeed been established *based on* previously established multiplex ties. Does a relation between individuals who connected formally and informally previously transform into one that indeed also includes exchange on innovative knowledge in the innovation network? To address this question we conduct logistic regression analysis, following the dichotomous nature of network data. Logistic regression (Table 6.7) allows one to predict, in this case, the formation of new innovation ties at the individual level, by the prior formation of multiplex, formal-only or informal-only ties. It is noteworthy that not a single innovation tie emerged at t=2 that does

not have one of the other tie types at its foundation. Only the beta for multiplex ties is a positive predictor of newly established innovation ties (b = 1.070; Hosmer and Lemeshow's R^2= 0.122). Formal-only and informal-only ties (b = -0.721 and -1.162 respectively) actually are negative predictors for establishing innovation network ties at t=2. Multiplex ties established beforehand explain the subsequent creation of new innovation ties.

Tie types	**B (SE)**	**Wald**	**95% C.I.** for EXP(B) **Lower**	**Upper**
Multiplex (at t=1) (formal **and** informal)	*1.070*** (.387)*	*7.646*	0.217	1.088
Formal-only (at t=1)	*-0.721** (.411)*	*3.076*	0.122	0.803
Informal-only (at t=1)	*-1.162** (.481)*	*5.833*	1.366	6.227
Constant	*0.860** (.360)*	*5.720*	–	–

Table 6.7: Predicting the establishment of new innovation ties (at t=2)

*Standardized coefficients. *** p<0.001, ** p<0.01, * p<0.05; Logistic regression. R^2= 0.122 (Hosmer and Lemeshow), 0.121 (Cox and Snell), 0.185 (Nagelkerke). Model Chi-squared (3)=79.80, p<0.01; None of the variables listed were found to have tolerance levels <0.26 or VIF values >3.7, excluding collinearity.*

Based on a Pearson's chi-squared test we can determine how sizeable this effect of a previously existing multiplex tie upon the likelihood of a new relation in the innovation network to emerge actually is. Formation of a new innovation tie after the intervention based on the prior establishment of a multiplex tie is substantial (Cramer's V = 0.358; $\chi^2(1) = 79.481$, $p < 0.001$). To quantify the strength of the association between both variables we calculated the odds ratio. The odds ratio (8.2) suggests that the probability of the creation of a new innovation tie is 8.2 times more likely if combined with the prior establishment of a multiplex tie as compared to a formal-only or an informal-only tie.

We have thus established that multiplex ties are largely coherent with ties in the innovation network. What is more, we show that establishing a tie in the innovation network can be predicted by the prior existence of a multiplex tie (rather than a formal-only or informal-only one). This predictive power also is sizeable. In all, we provide strong evidence in support of proposition 4.

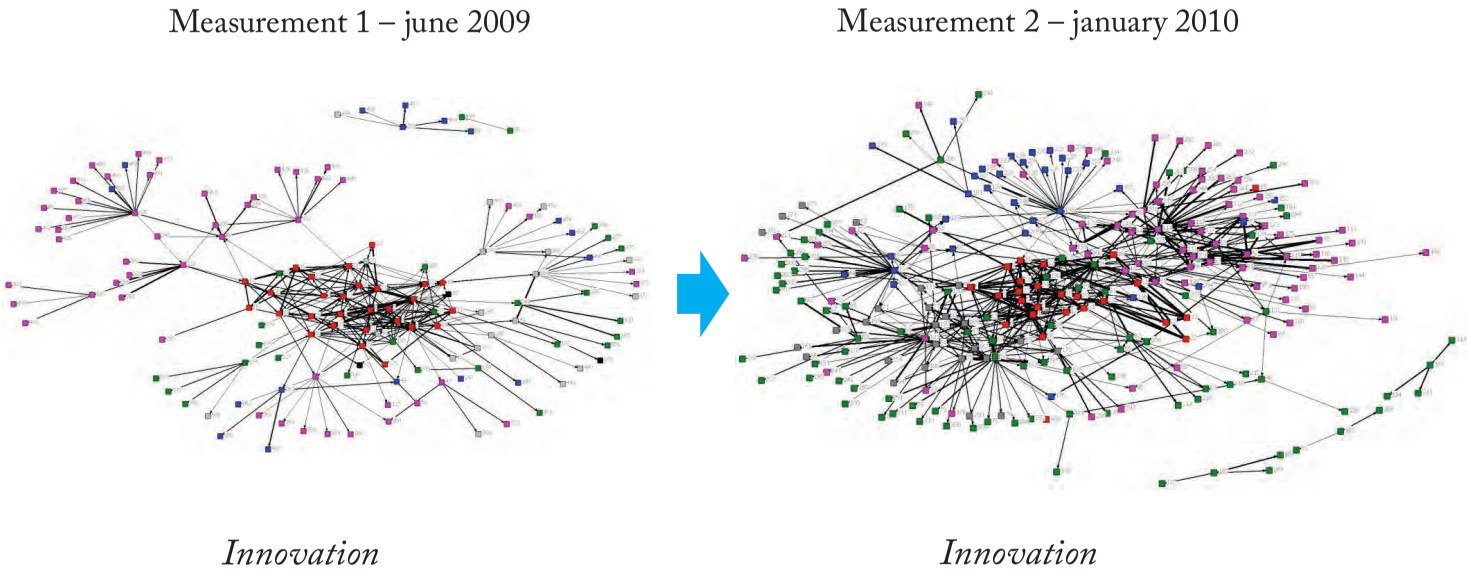

Figure 6.1: Innovation network, before and after intervention (t=1 and t=2)

6.5 Conclusion and discussion

This study investigates the effects of a 'simple formal intervention' by management to boost involvement with exchange of innovative knowledge among employees at a large European financial service provider. We offer three contributions to the management literature in our study. Firstly, formal intervention can support the development of the network characteristics commonly found to facilitate involvement in innovative knowledge transfer. Sheer access to others, as well as, separately, access to a diversity of others in the innovation network substantially increases due to an intervention and, surprisingly surges in particular among employees that were already somewhat involved in innovative activities but who were not primarily focused on innovation ('realizers' respectively 'creators'). Secondly, we find that formal intervention is capable of stimulating newcomers to enter into the innovation arena. Thirdly, we find that new innovation ties developing over time are very likely to be established on a multiplex foundation of combined formal and informal relationships that existed previously. Multiplex intra-organizational relationships are thus of great importance for the establishment of an innovative organizational climate. Involvement in the exchange of innovative knowledge can thus be substantially increased by a simple formal intervention and surges in particular among employees that were not primarily focused on innovation beforehand. The study thus contributes to an understanding of how involvement in innovation activities within a firm evolves over time (Kijkuit and Van den Ende 2007), and, importantly, how management might affect involvement with such activities. The strong increase in innovation involvement among realizers and newcomers in comparison to creators in number of overall ties as well as in the amount of cross-unit ties suggests that a firm may have an untapped reservoir of innovation potential that can be relatively easily tapped into.

Adding ties within one's unit, notably in the innovation network where complex and tacit knowledge is exchanged, appears to be (much) easier than adding ties in the innovation network that cross unit boundaries. The first does not go at the expense of the second, but the opposite seems to be the case. In contrast to what is (implicitly) suggested by some research (Haas and Hansen 2005), communication costs involved in maintaining ties of different natures can thus differ. Employees who had been maintaining a large number of costly relations prior to the intervention may ignore opportunities for initiating relationships with new partners that an

intervention offers (Gulati 1995; Tsai 2000), if it were not for a formal intervention by management.

Even though creators are not much affected by the formal intervention that aimed to stimulate what is the core of their activities, they nonetheless maintain a much larger number of innovative relationships and cross-unit contacts than individuals in the other groups. This observation is supportive of work by Tsai (1998) who showed that people from different organizational units have varying levels of 'strategic linking capability'. Tapping the innovation potential available in a firm as a whole, beyond the group of creators, may well only be possible if a core group of creators is present to begin with. There is a need for additional research comprehensively studying the development of formal, informal and innovation network structures over time (cf. Kijkuit and Van den Ende 2007; Aalbers *et al.* 2012), and, from a management perspective, particularly how such dynamics might be affected by interventions.

Even when management is forced to reach the goal of an intervention in a mediated way, the effects of an intervention can be substantial. At the same time, our findings suggest that an intervention can have effects that go beyond changes in behavior in the target population. To determine the ways and extent to which effects of a formal intervention can be found beyond the target population, the exact parameters of the intervention must be further studied. In relation, we find no significant effect for the 'value of input' exchanged to explain involvement in the innovation network. This is surprising since one would expect that involvement in exchange of new, innovative knowledge will be enhanced when the value of what is exchanged is high, and may relate to individual motivation. It is here in particular that an experimental research setting may be helpful, even though the effects or the workings of tie multiplexity may be quite different in an experimental setting.

Limitations and future research

Our research was of exploratory nature and as such clearly has a number of limitations. First, we looked at intra-organizational networks within a single firm. We believe that our findings are generalizable to other firms, however, but further research must confirm this (cf. Siggelkow 2007). Secondly, no data was available to measure the outcomes of the involvement in innovation activities in the innovation network at the individual, the unit or the firm level. Future research could investigate

if a simple formal intervention might have different effects if other goals than enhancing involvement of employees with innovation are to be reached.

We have found that multiplex ties are important in an organization – newly formed ties in the innovation network are based on multiplex ties combining formal and informal aspects of a relation that had been in existence earlier. How such multiplex ties evolve over time, and if they can also constitute a disadvantage is in need of further research. Under what circumstances do multiplex ties survive over time, or alternatively, break down in pure ties again? Little is discontinuation of social relations, and the breakdown of social capital, studied (Dolfsma *et al.* 2009).

Chapter 7

Innovation Resilience Despite Corporate Downsizing: Benefits from Positioning in the Formal and Informal Network[20]

7.1 Introduction

Downsizing, as a particularly radical form of corporate change, is an important instrument for firms to reestablish alignment between strategy and organization (Chandler 1962; Gulati and Puranam 2009). Many such corporate change efforts do not proceed as planned, are ineffective (e.g., Greve 1998; Beer and Nohria 2000; Kostova and Roth 2002), and might actually have negative effects for a company (Guthrie and Datta 2008; Datta *et al.* 2010). Downsizing is particularly believed to hurt a firm's innovativeness over time (Mellahi and Wilkinson 2008; Brockner *et al.* 1987; Amabile and Conti 1999; Bommer and Jalajas 1999; Dougherty and Bowman 1995; Bommer and Jalajas 1999; Shah 2000; Fisher and White 2000). Remarkably there is little empirical support for this claim: to date, no empirical research has studied the impact of downsizing on innovative activity within organizations (cf. Gandolfi and Oster 2010; Mellahi and Wilkinson 2008). The exploratory study of

[20] This chapter is based on Aalbers, H.L. and Dolfsma, W. (working paper). "Innovation Resilience despite Corporate Downsizing: Benefits from Positioning in the Formal and Informal Network". An earlier version has been presented at the 2012 Academy of Management Conference in Boston, Massachusetts (USA) and the 2012 Sunbelt Conference at Redondo Beach (USA).

Dougherty and Bowman (1995) is an exception.[21] This lack of research is remarkable given that innovation is a key source of a firm's competitive advantage (cf. Zander and Kogut 1995).

Downsizing dissolves social relations forcefully (Nixon *et al*. 2004; Fisher and White 2000), and so retaining the social infrastructure for innovation is by no means evident. Innovative capacity is a premier avenue towards corporate recovery following organizational decline (Mone *et al.* 1998; Bolton 1993; Ocasio 1995) – either of the externally imposed or self-inflicted kind. To determine the extent to which a firm can expect its innovativeness to recover after downsizing, the potential changes in the way in which employees collaborate need to be studied. Through collaboration, in social networks, relevant information is generated, screened and dispersed, and knowledge is developed, laying the foundation for organizational innovative capacity (Amabile and Conti 1999; Campbell *et al.*1986; Coleman 1990; Granovetter 1973; Burt 2004). Actual analysis of pre- and post-downsizing patterns of interaction between individuals has not been carried out, to date, however. If at all studying collaboration patterns in downsizing firms, only a single, ex post measurement is available and the focus may not be on the strategically significant innovativeness (see Fisher and White 2000; Shah 2000; Dougherty and Hardy 1996). Employee anxiety due to downsizing is more typically studied. Adopting a longitudinal network perspective, in an in-depth case study-setting, uniquely, we empirically investigate the effect of downsizing on corporate innovativeness.[22]

Downsizing, a particularly radical form of management intervention, will have a primary effect on people's presence and activity in the formal network as functions disappear and are redesigned. The location where people are based, and the way in which their function is defined determines to an extent with what others they interact informally as a matter of course. Since innovation, to most in a company,

[21] Based on a number of interviews across a variety of companies, Dougherty and Bowman (1995) suggest that downsizing hinders product innovation in particular. Framed as an ex post study,, asking about respondents impressions of the effects of downsizing and framed at the overall firm level, the study does not compare situations over time and does not study firm-internal developments.

[22] Network data itself is difficult to collect given the high methodological standards involved, even for a single observation. Network data can be perceived as strategically important by firms even in non-turbulent periods. We had planned multiple data collection moments for the firm before we learned about the impending downsizing.

is extra-role or discretionary, these two ways of interacting -formal and informal- may determine with whom one will exchange new and innovative knowledge. We argue that someone may be expected to continue to be actively involved with innovation in a firm that experienced downsizing if prior to this downsizing he is in a position to control information in his immediate surrounding (his direct network) as well as information flows in the whole intra-organizational social infrastructure (his extended network), in both the informal as well as the formal networks. Such individuals contribute more to the innovative capabilities of a company, but may also be more likely to influence the direction of a necessarily incompletely scripted downsizing operation in a way that is beneficial to them.

Section 2 discusses downsizing as a prime example of top-down organizational change by management in the pursuit of strategic goals. We do so from a social network perspective. We hypothesize here that continued involvement in the innovation network is due to control that people hold in the formal and informal networks over information flows. Control can be based on either their direct or extended social environment. Section 3 describes the research setting, data and analysis, whereupon Section 4 presents results. Section 5 discusses implications, concludes and makes recommendations for future research.

7.2 Theory and propositions

Downsizing and network structure over time

Corporate change can be convergent or radical in scope, and either evolutionary or revolutionary in pace (Greenwood and Hinings 1996). A radical form of corporate change, downsizing has been a managerial practice for increasing organizational efficiency and effectiveness during the last two decades (e.g., Budros 1999; Cameron *et al.* 1991; De Meuse *et al.* 1994; Littler 2000). The goal tends to be to improve efficiency of a firm by decreasing costs, enhancing revenues, or increasing competitiveness (Datta *et al.* 2010; Freeman and Cameron 1993). Downsizing may thus coincide with corporate reorganization or the planned replacement of the current organizational structure and operating model with a new, for instance more customer-centric one (Tushman and Romanelli 1985; Gulati and Puranam 2009). A firm's existing orientation will change (Miller 1990) as its strategy shifts relatively abruptly (Freeman and Cameron 1993; Agarwal and Helfat 2009). Downsizing

is typically implemented top down, often with support of external change agents to manage the change process (Augier and Teece 2009). By contrast, incremental change consists of smaller adaptations realized over relatively longer time spans to maintain organizational stability in the long run (Plowman *et al.* 2007; Freeman and Cameron 1993; Tushman and Romanelli 1985).

Research on network structure under conditions of uncertainty indicates that network cohesion is likely to increase (Weller 1963; Hassan-Murshed *et al.* 2010). There might be several reasons for this. Individuals will communicate more to reduce the perception of uncertainty (Albrecht and Ropp 1984). Individuals trying to decide among important and risky alternatives are likely to consult with each other, relying on friends and colleagues for advice, thereby increasing the level of network cohesion (Coleman *et al.* 1966). Those who survive a reorganization will thus be more connected than was true of the population before. Heightened levels of risk aversion among downsizing survivors may lead to favor interaction with others who are similar to them (Cascio 1993) – fault lines deepen. Increased network cohesion directly following downsizing will result as diversity of information exchange and creativity reduce (Uzzi *et al.* 2007; Sethi *et al.* 2001; Gargiulo and Benassi 2000).

Clique formation and increased stratification appear in any organizational network under conditions of organizational disintegration (Hassan-Murshed *et al.* 2010; Tutzauer 1985). Thus, as stress and uncertainty increase, employees tend to flock together with others in their direct environment and unconnected or less well-connected individuals may be the first not to be able to escape the consequences of downsizing. Strongly cohesive networks are conducive to focused collective action. Interests and perspectives for such (sub-) groups are aligned or normatively constrained, and the language and trust necessary to mobilize interests are more readily available (Granovetter 2005; Obstfeld 2005). Hence, as downsizing creates similar significant stresses and tensions among employees (Nadler and Tushman 1998; Romanelli and Tushman 1994; Tushman and Romanelli 1985) we expect the various indicators of cohesion to increase directly following this type of drastic intervention.

> ***Proposition 1:*** *Overall network cohesion for the formal, informal as well as the innovation network increase directly following downsizing.*

Innovation resilience because of individual control over information flow

As downsizing has significant implications for employees, these individuals may exert influence as they deal with anxiety and uncertainty (Brockner *et al*. 1993). Even in a relatively well-scripted (Barley and Tolbert 1988) and well-defined situation individuals can exert their agency (Dolfsma and Verburg 2008). No script of any situation can be closed in the sense that all aspects of behavior are prescribed in full (Dolfsma *et al.* 2011). The script of a downsizing operation will certainly not be a closed one. Employees may be expected to exert influence to change the course of a downsizing operation, to their own benefit and to that of the firm. Shah (2000) found that negative as well as positive survivor reactions can affect the intended benefits of a layoff. The influencing behaviors of affected individuals stem from the control they have over information flows in a firm. Control might come from the immediate contacts someone has, or from his position in the overall network including indirect contacts. One's position prior to downsizing can then, we argue below, affect one's continued involvement with innovation afterwards. This can only be expected, however, if overall network structures remain stable. Control over information flows in the formal and respectively informal networks can then allow someone to continue to be involved with innovation despite corporate downsizing.

Social exchange theory (Cook and Emerson 1978) and arguments from resource dependence theory (Pfeffer and Salancik 1978) suggest that an actor's control is rooted in the dependence of others on the resources regulated by the actor. In the context of a network of relationships, information is exchanged and access to it is a valued resource (Ibarra 1993). Individuals in a position that allows for control over the information flow prior downsizing, in either the formal or the informal network, will see their involvement in the innovation network persist. These individuals constitute the foundation for the resilience of the innovation network after downsizing.

The concept of an individual's control over information flows has received considerable attention (Burt 1982; Brass 1992; Ibarra 1993). An individual's capacity to control the flow of information is derived from his position in the network. Downsizing will, largely exogenously, impact organizational networks and will then have different consequences depending on one's position prior to downsizing. One can control the information flow in a network (1) among one's direct contacts, or (2)

derive control from one's position in the complete network. We refer to the first as direct control or (Bonacich) power, and to the latter as extended control.

Direct control of information flow (Bonacich power)

An individual's immediate contacts in a network can be a basis for control over information flows in an organization (Ibarra 1993; Brass 1992). Actors can seek to align and coordinate action of one's own connections as well as the connections of one's own connections (Bonacich 1987). This form of direct control is commonly referred to as an individual's direct power base (Ibarra 1993). If one has a larger number of connections, who also have a larger number of connections, one's individual network power is higher (Bonacich 1987*)*. Being more powerful in this way provides one with alternative sources of information and can allow one to strategically disseminate information. This power can help someone to survive downsizing better. Ibarra (1993, p.472) observed that: "bringing about a change […] requires an individual to use power and influence to persuade others of the desirability and to mobilize support, information and material resources or to overcome resistance to change."

Extended control of information flow (betweenness)

Due to the uncertainty that comes with corporate downsizing, employees and entire organizational units may seek to strategically diffuse knowledge, perhaps in retribution to management. Employees may become reluctant to make suggestions to colleagues and information sharing can slow to a crawl (Bommer and Jalajas 1999; Gandolfi and Oster 2010). In such more conservative knowledge sharing circumstances, individuals who are centrally positioned prior to downsizing, in the full network (cf. Provan *et al*. 2007), may have advantages that may be referred to as *betweenness benefits*. Such individuals will receive information in larger quantities and of a larger diversity, tapping into the various corners of the organization beyond their immediate contacts. Employees fulfilling a strong betweenness position can seek to interrupt or steer the flow of information that spans the whole organization. Individuals well-positioned in the extended network – both the formal and the informal networks, as we will argue below – will particularly then be able to continue their engagement in innovative activity (Ibarra 1993). One's betweenness benefits extend beyond those deriving from one's local vantage point providing direct individual power, to include extended network benefits such as the bridging

of structural holes (Mehra *et al*. 2001). Individuals with ties across social divides have been found to gain non-redundant information concerning opportunities and resources (Burt 2004; Mehra *et al.* 2001; Granovetter 1973).

Control of information flows in the formal and informal networks

Bonacich power and Betweenness benefits may be expected in the formal and the informal networks in an organization. Gulati and Puranam (2009) have argued that the structure of and effects to be expected from the informal network in an organization can be very different from the formal network. The formal (workflow) network comprises of the interaction patterns between employees to successfully carry out their *daily activities* within the organization that are prescribed or mandated by the organization (Mehra *et al*. 2001; see also Brass 1984; Brass and Burkhardt 1992; Cross and Cummings 2004; Whitbred *et al.* 2011). It is impossible to understand processes within the organization without investigating the influence of the informal relations, however (Blau and Scott 1962). The informal network comprises of these interaction patterns between employees that take place to stay in tune with what is going on within the organization that are of personal relevance (cf. Brass 1984; Ibarra 1993; Mehra *et al.* 2001; Smith-Doerr *et al*. 2004; Rodan 2010). This informal circuit is also referred to in more popular terms as the 'organizational grapevine' and provides insight into the general way 'things are getting done' within the organization (Cross *et al*. 2002; Umphress *et al*. 2003). These relations may by-pass the formal communication structure (Schulz 2003). Formal relations are thus designed or mandated by the organization, while informal relations are emergent, discretionary or extra-role. Even though the two networks can in practice be related (Aalbers *et al.* 2012), they are conceptually and methodologically different and can have very different effects for the organization and its internal information flows. To bring out these differences, we analyze the position that an individual has in either of these two networks separately.

***Direct* control in the *formal* network**

Individual power positions in the formal or workflow network can support innovative activity (Ibarra 1993). The formal network is a relatively transparent network, making it easy to locate knowledge and expertise. In the formal network decisions about resource commitments and allocation are made (Aalbers *et al.* 2012).

A power position in the formal network, through having more direct connections, might allow one to push one's own innovative interests by controlling the formal flow of information, for instance. In times of organizational turmoil those who hold a powerful position in the formal network prior to a significant organizational change may be able to influence the allocation of what resource dependence theory calls 'critical' resources to their advantage. The control of the flow of work related information prior downsizing may be expected to allow someone to call in personal favors of one's direct surroundings that can be deployed to continue the support of innovative activity (Pfeffer and Salancik 1978; Thompson 1967; Rowly 1997; Dolfsma *et al.* 2009). It is these individuals in strong formal power positions that benefit from information asymmetry that typically increases in periods of reorganization, emphasizing the differences between powerful and unconnected individuals. Relatedly, being more involved in the flow of work-related information in the formal network makes someone that fulfills such a position worthwhile to stay in touch with (Tushman and Nadler 1977; Bozionelos 2008). The scarceness of information and the overall uncertainty accompanying downsizing might amplify this effect. Research has accordingly shown that the power position in a formal network increases the likelihood of being perceived as a valuable and knowledgeable ally (Allen 1977; Tushman and Scanlan 1981). This leads us to the following proposition:

> ***Proposition 2a:*** *In the formal network prior corporate downsizing, control over the direct information flow by maintaining a high individual (Bonacich) power position contributes to the resilience of innovation ties.*

Extended control in the formal network

The formal network has been found to be a prime base for one's (perceived) ability to understand and influence the going-ons within an organization in the broadest sense or to be in the loop of things (Whelan *et al.* 2011). As we approach the flow characteristic based on what actually passes – or does not pass – between employees as they interact, the potential to be on the shortest path of what flows through the formal network may be a prime indicator of the degree to which individuals are capable of controlling the respective information (Borgatti and Halgin 2011). In the formal network, information flow is intended and perhaps mandated, it is role- or function-internal and, as a result, more transparent.

Control over the formal, work-related flow of information has been linked to individual's ability to generate organization wide commitment and exposure to innovation activities (Aiken *et al*. 1980; Ibarra 1993; Shah 2000). As an indicator of extended control, high betweenness centrality, recognized as the prime indicator of the information control capability within an overall network (Freeman 1979; Shah 2000; Borgatti and Halgin 2011; Borgatti and Everett 2006), helps to bring innovative activity to the attention of management, might generate positive publicity in an organization, and might hamper or block-off competing formal activity (Bonner *et al.* 2002; Kijkuit and Van den Ende 2007; Aalbers *et al.* 2012). Evidently these benefits differ from these derived from merely controlling one's direct formal social environment as they implicate a broader network 'reach' and include the advantages associated with bridging structural holes (Burt 2004).

A favorable position in the extended formal network that allows for control of the work-related information flow might enhance the likelihood of continuing one's innovative ties, even under conditions of organizational turmoil. Combining the output of these innovation ties with one's control over the formal information flow under conditions of increased information asymmetry might render interesting individual (economic) payoff. Leveraging on one's formal network reach might enable a person to enrich and pass on more original information to a diversity of others, allowing this person to continue to be perceived as valuable to the organization. In addition, a prior central position in the extended formal network may enable the capacity to influence those elements of the reorganization plan that were left for closure at some later stage. A prospect that is expected to foster the resilience of one's individual innovation related ties.

As individual networks are expected to be streamlined under corporate and social uncertainty, we expect employees that exercise control over their extended formal social environment (betweenness centrality) to be most capable to hold on to their innovation ties (Shah 2000). Hence we propose:

> ***Proposition 2b:*** *In the formal network prior corporate downsizing, control over indirectinformation flow in the whole network by maintaining a high betweenness position contributes to theresilience of innovation ties.*

***Direct* control in the *informal* network**

The network of informal contacts comprises of those non-mandated contacts that allow individuals to acquire information about what is going on in their organization (Szulanski *et al.* 2004). This corporate grapevine might possibly take short cuts compared with the formal organization and hence is a valuable ground for information complementing one's formal channels (Cross *et al.* 2002). Norms, values, and beliefs get shared through it (Lazega and Pattison 1999; Schulz 2003). Even though an informal network can be intransparent and a source of resistance to the necessary changes, it can also be a way to transfer new ideas more easily (Albrecht and Ropp 1984; Hansen 2002).

Earlier research has shown that informal power may well deviate from formally designed power structures (Cross and Prusak 2002; Krackhardt and Hanson 1993; Aghion and Tirole 1997) and is critical to the support for innovative activity and innovative outcomes (Allen 1984; Aiken *et al.* 1980; Tushman 1977; Ibarra 1993). Kanter (1983) argued that power acquired through informal network connections is most eminent. Highly uncertain times might require extensive extra-role activity to stay in the loop of things and so an individual's power derived from the organization's informal structure may even be more critical than its equivalent based on the formal structure in such times (Ibarra 1993). Individual power in the informal network, the ability to favorably influence one's immediate social environment, is a necessity for a new idea to be actually approved or tolerated, let alone to be implemented (Kanter 1983, 1988; Allen 1984). In cases of substantial change to the organization, when the resulting formal structure is to a large part unclear, the position in the informal network prior to reorganization might be a source of influence for individuals (cf. Bacharach and Lawler 1976). Employees that are known to be established informal power figures might be seen as blessed with new as well as recent insights on one's direct social surrounding and hold specific (political) knowledge, and would thus be approached by others for guidance (Aalbers *et al.* 2012). These individuals are likely to have established themselves as interesting counterparts for innovative matters as well (Tushman and Scanlan 1981; Westley and Vredenburg 1997). This points us to proposition 3a:

***Proposition 3a**: In the informal network prior corporate downsizing, control over the direct information flow by maintaining a high individual (Bonacich) power position contributes to the resilience of innovation ties.*

Extended control in the informal network

The informal network is largely discretionary and non-mandated (Ibarra 1993). These ties are costly to build and maintain, however, and their existence is not necessarily supported by the organization (Tsai 2000; Haas and Hansen 2005). Personal benefits reaped by involvement in these contacts might include job satisfaction, enhanced morale, and promotion (Allen 1970; Keller and Holland 1975; Tushman and Scanlan 1981; Bouty 2000). Although not formally mandated, an employee's earlier central position in the whole informal network – measured by betweenness centrality – gives rise to reputational effects that might be beneficial to the individual and the organization (Pettigrew 1972). Controlling information flows in the informal network is believed to benefit one's ability to sustain innovation ties.

A prior reputation for being informally 'in the loop of things' make that such highly central individuals in the informal network prior to downsizing are more likely to hold valuable information, also when parts of the formal organizational structure disintegrate or are re-designed. Control over the informal flow of information throughout the organization prior downsizing renders individuals attractive partners with whom to continue to maintain relations. As formal positions might require more time to re-establish and settle, informal positions are likely to allow one to be among the first to pick up on new things that could be beneficial to the success of ongoing innovative activity (Cross and Parker 2004). In a way, partnering with those that held a central betweenness position in the informal network Prior to reorganization might be an economic decision, increasing the changes of continued inflow of worthwhile novel information that extends beyond one's direct informal milieu. What is more, as the information is not formally mandated, it has the potential to be more diverse and non-incremental in comparison to the information transferred in the formal network (Cross and Parker 2004). A central position in the whole informal network allows an individual to have access to a diversity of informal information sources from across different hierarchical layers and fields of expertise. It allows an individual to anticipate better what the organization is headed for, apart from what is formally communicated, and what is expected of people under

the new circumstances. Information acquired through the grapevine may be used by the individual to re-position innovative activities in a way that is most deemed to fit with the future organization, even when this future organization has not had the chance to be formally established yet. This to assure that one's innovative activity will be furthered by the organization as effectively an as soon as possible, increasing the chances of enhanced personal satisfaction and social recognition of the individual innovator's actions (Amabile 1997; Teigland and Wasko 2009). In sum, one's control over the extended information flow (betweenness centrality) in the informal network prior downsizing is expected to encourages one to sustain innovation related contacts as they enable continued or expected earning of rents (Salter *et al.* 2009) and form fertile grounds for swift individual achievement post-reorganization. This leads us to the closing proposition:

> ***Proposition 3b:*** *In the informal network prior corporate downsizing, control over indirect information flow in the whole network by maintaining a high betweenness position contributes to the resilience of innovation ties.*

7.3 Method

Research design and procedure

Data collection took place at Beta Company, a leading financial services company. We collected network and other data prior to and after corporate downsizing – a rare and unanticipated opportunity. The reorganization was executed by way of a typical top down approach and took place over a period of a year. Overall, the workforce was reduced by over 30%. Reorganization activities followed after a long period of market, corporate and social stability at Beta Company, introducing corporate as well as social uncertainty as a relatively new phenomenon. The reorganization was planned and executed in close collaboration with a strategic change advisory. In contrast to earlier network studies in the context of downsizing (Shah 2000), the organization studied here is characterized by its knowledge intensive nature and strong focus on innovative solutions for its customers. Companies may be reluctant to participate in a network study, in particular in times of reorganization, because of the sensitive nature of the information involved (Shah 2000). This study was carried

out as part of a broader study on network dynamics that commenced before the reorganization was officially announced.

Data collection

Through a recurrent network survey and semi-structured interviews we collected data at different moments in time. Interviews served three purposes: (1) to become familiar with the organization, (2) as the first round in our snowball sampling procedure to collect data and, (3) to understand our quantitative findings in the appropriate qualitative context.

Collection of the first dataset (t=1) was finalized in the month prior to the formal announcement of the reorganization.[23] The collection of the second set (t=2) took place directly after the execution of the first and primary wave of downsizing. At each time a network survey was deployed based on snowball sampling procedure, a method commonly applied in network analysis studies and especially useful when the target population is not clear from the beginning or when it may cut across unit boundaries (Wasserman and Faust 1994). For both datasets the target population emerged in several rounds of surveying, where contacts mentioned in one round determine who should be approached as a respondent in a subsequent round. To exclude the risk of mistakenly ignoring 'isolates' who are relevant respondents and are involved in exchange of new, innovative knowledge but who are not well connected, we targeted respondents with differing backgrounds in our first round of data collection (Rogers and Kincaid 1981).

The innovative knowledge sharing network was measured by asking individual respondents with whom they discussed new ideas, innovations and improvements relevant to the company (Borgatti and Cross 2003; Cross and Prusak 2002; Rogers and Kincaid 1981; Rodan 2010). We measured the formal (workflow) network by asking respondents with whom they interact to successfully carry out

[23] This chapter draws from the dataset collected at Beta Company as part of a data collection project that was executed over a period of 2 continuous years. In this period 3 separate data panels were collected under identical data collection script and method. The disruptive nature of a corporate downsizing program that was carried out at Beta Company between collection of data panel 2 and 3 allowed for the presentation of findings as two separate datasets, elaborated upon in two separate chapters (6 and 7) with distinct theoretical framing. The first data panel presented in this study (chapter 7) therefore equals – what is referred to as – data panel 2 in the study presented in the previous chapter (chapter 6).

their *daily activities* within the organization that were prescribed or mandated by the organization (Mehra *et al*. 2001; see also Brass 1984; Brass and Burkhardt 1992; Cross and Cummings 2004; Whitbred *et al.* 2011). The explicit focus is on existing products and services that have already been developed, or relations that had already been established and follow from the respondent's assigned role or position in the organization. Following Ibarra (1993) and Brass (1984) we measured the informal network by asking respondents with whom they discuss what is going on within the organization in confidence to get things done that are of personal relevance to them (cf. Mehra *et al.* 2001; Smith-Doerr *et al*. 2004; Rodan 2010), allowing us to picture the 'organizational grapevine'. As this informal network provides insight into the general way 'things are getting done' within the organization, it identified one's confidants for personal support (Rodan 2010; Umphress *et al*. 2003). These relations may by-pass the formal communication structure (Schulz 2003). Formal relations are thus designed or mandated by the organization, while informal relations are emergent, discretionary or extra-role. To reduce ambiguity, network questions were formulated in the native language – Dutch and English. We did not set a maximum number of contacts respondents could enter as that might unduly affect network structure (Friedman and Podolny 1993; Huang and Tuasig 1990). This generated new names involved in the three networks included in the study (formal, informal, innovation).

We adopted a snowball approach to identify individuals involved in the networks. The selection of names to start the snowball approach with was validated by the heads of the different units involved in innovation activity. Round one of this approach yielded a response rate of 92%, with 78 out of 85 respondents identified in the innovation network filling in the questionnaire, further identifying 241 individuals in the innovation community. Round two directly following the downsizing returned a response rate of 78%, pinpointing 175 individuals as part of the remaining innovation community (for the full descriptives per network see Table 7.1). Response rates this high limit the possible negative effects of missing data points in social network analysis and are considered to certainly be acceptable response rates for a whole-network approach (see Wasserman and Faust 1994; Kossinets 2006; Grosser et al. 2011).

In addition to the network data, 20 semi-structured interviews were conducted with employees undergoing the reorganization as well as with those carrying out

the downsizing program. This provided contextual input in addition to the network data collected via the online questionnaire. Interviews typically lasted one hour, were recorded and transcribed, and were conducted with survivors, executioners as well as employees that had to leave the company by t=2. In addition to the scheduled interviews, we studied formal communication on the downsizing as posted on a dedicated intranet portal of Beta Company and background program information based on the initial program plans.

Operationalization of variables

Network connectivity, also referred to as network cohesion, describes the extent to which employees are connected via direct or indirect ties at the network level (Wasserman and Faust 1994; Entwisle *et al.* 2007, p.1508). To determine *cohesion* we measured density, transitivity and reciprocity in a network (van Duijn *et al.* 2003; Brewer and Webster 1999; Hassan-Murshed *et al.* 2010). These cohesion measures are based on the connectivity of the network or the ability (inability) of actors to reach others, directly and via indirect paths. Studying structural network properties, cohesion measures provide us with important insights on the robustness of an organizational network (White and Harary 2001).

Cohesion

Density was measured as the actual number of ties per network divided by the maximum number of ties that are possible (Kilduff and Brass 2010). The more dense the network, the more redundancy there is in terms of alternative paths along which information and influence can flow between any two actors (Granovetter 2005). *Transitivity* was measured as the number of transitive triples divided by the number of potential transitive triples, serving as indicator of the overlap in employee relationship circles (Kilduff and Brass 2010; Hanneman and Riddle 2005). As such, three actors (A, B, C) are transitive whenever A is linked to B, and B is linked to C, when C is then also linked to A. *Reciprocity* is present if actor A is directly connected with actor B and actor B is directly connected with actor A and indicates the degree of two-way interaction (Hanneman and Riddle 2005).

Innovation tie decline (delta pre- to post-innovation)

Defining innovation as the development of ideas to improve products and services or develop new ones, the innovation network is the pattern of social relations to exchange, support and bring about these new ideas (Albrecht and Ropp 1984; Rodan 2010). Downsizing may be expected to disrupt existing social networks (Shah 2000; Dougherty and Bowman 1995; Brass *et al.* 2004), even when it can only be aimed, off necessity, at the positions and relations in the mandated formal network only. Relations in the informal and the innovation networks will, however, be affected as well. The D-in-D estimate is the delta or change of number of innovation network ties, comparing t=1 with t=2, based on in-degree centrality. As our dependent variable, it measures the change (reduction) in innovation ties due to the reorganization. Calculated for each individual in the innovation network, this variable can be referred to as 'delta (Δ)'. Centrality is usually regarded as a signal of the degree of collaboration and diffusion of knowledge within a network (Patrakosol and Olson 2007; Podolny and Stuart 1995; Liu *et al.* 2011), and the in-degree measure is more reliable than the self-reported out-degree measure (Costenbader and Valente 2003). We correct for network size as the innovation network size changes over time.

Direct control – Individual network power

From a network perspective, power is a distinctly different construct of an individual's position than centrality (Cook *et al.* 1983). Those who are most central are not the most successful in exercising bargaining power (Bonacich 1987, p.1170). Although power is also based on individual position within intra-organizational network structures, the basis of power in a network is not the accumulation or early reception of different resources by individuals themselves. This is what degree centrality captures. Power in a network, referred to as Bonacich power, is derived from the ability of actors to align and coordinate action of one's own connections as well as the direct connections of one's own connections, (Bonacich 1987). Equation 1 shows how one calculates Bonacich power. Here c is the derived nodal attribute power score for i, R is an adjacency matrix, while α and β are scaling factors. When β=0 this measure would equal the degree centrality measure and be independent of the shape of the full network.

$$c_i(\alpha,\beta)=\sum_j(\alpha-\beta c_j)R_{i,j} \qquad \text{(Eq.1)}$$

Following Paruchuri (2010) and Borgatti and Halgin (2011) we calculated the Bonacich power score for each individual in the formal and informal networks prior downsizing. Since Bonacich power values will vary by node depending on the total number of nodes and edges present in the network, we normalize the values of power.

Extended control – Betweenness

Betweenness measures the strategic importance of an actor within a whole network by recognizing the importance of the geodesic paths between *all* actors involved in the full network. Betweenness assesses the proportion of edge-independent paths that involve a given node, measuring paths in the network that would not exist if the particular node were not present (Borgatti and Everett 2006). The betweenness measure is an indication of the control a node has over the diffusion of knowledge or information in the whole network. We calculated this *ego* betweenness measure for each individual in both the formal and informal network prior to downsizing (Hanneman and Riddle 2005; Wasserman and Faust 1994).

Control variables

We follow Shah (2000) to control for a number of demographic variables, membership of a functional work group, gender, hierarchical level, and tenure. We included tenure to control for the amount of time an individual has had to develop relations over the years (Gundry 1993). Tenure has been related to positions of control and innovative capacity due to systemic legitimacy and knowledge of how to navigate an organization's political waters (Ibarra 1993; Zenger and Lawrence 1989). Hierarchical level has been linked to one's formal and informal power base, as well as access to information and resource flows (Ibarra 1993; Baldridge and Burnham 1975; Aalbers *et al.* 2012) and for this reason is also included as a control variable. Gender and functional work group were added to control for group affiliation effects. In addition, we controlled for individual network density since the group dynamics or exchange patterns can differ between networks of different densities. Prior studies have linked (individual) network density to individual's knowledge retention capabilities (Reagans and McEvily 2003; Schmitt *et al.* 2011). As radical downsizing with a workforce reduction of over 30% might be expected to disrupt network density at the individual level due to the disconnection of random actors

and hence potentially disturbs knowledge retention capability, we also control for this value over time. Controlling for value of innovative input offered for exchange by an employee, reported by those that directly interacted with them, is calculated as an average value to correct for number of respondents per individual. Interactions of ego with alters can be different if ego has more valuable knowledge to exchange compared to when they have not, irrespective of the number of relations. One might expect that value of innovative input offered to change (decline) as a result of downsizing as no immediate use might be perceived by those receiving the input, and so this possible effect needs to be taken into account.

Formal and informal networks may be strongly interrelated (Chapter 2), but may have effects that are different and are in need of differing explanations. We thus emphasize the need for this study, to test the effect of the formal and informal network characteristics on innovation tie decline due to a reorganization separately. In this way, we avoid conceptual confusion, but also prevent difficulties of interpreting findings that might arise from statistical complications (multicollinearity in particular).

7.4 Results

The reorganization at Beta Company had clear objectives and a detailed program. In addition to efficiency objectives, the goal of management was to align the firm's structure more closely to its markets. Relatedly, it was expected that newly developed products and services would find their way to the market more easily. In the words of an Operations manager: *'The reorganization will straighten out inconsistencies in the innovation process.'* Despite this being a stated goal, uncertainties among employees abounded. One interviewee expresses this succinctly: '*People find it difficult to come up with, or even discuss, plans and new ideas since these might actually lead to redundancy.'* An IT employee added to that: *'I am convinced that intervention is essential if we want to secure a bright future for our company. But having to watch people leave is not easy for anyone. It might very well proveto be difficult for quite a few of them to get reemployed elsewhere. I could be oneof them.'* The uncertainty for individuals that typically accompanies downsizing is adamantly clear in this case. An Operations employee reflects this: *'I and my direct colleagues are facing quite some uncertainty at the moment. The only actual certainty is that there will be people that will be asked to leave.'*

Network cohesion following downsizing

As we turn to the descriptives about the effects of the downsizing, Table 7.1 shows key information. As a result of the downsizing activities, the labor force was reduced by more than 30%, dropping from 1000 employees in 2010 to 700 employees in 2011. At the tie level we observe a similar shrinkage. Ties in the innovation network reduce by 36.6% in terms of absolute numbers. This reduction is slightly *less* than the reductions in the formal and informal networks: minus 39.2% and minus 40.1% respectively. Note however that there are also newcomers[24] to the innovation network: a group that was already employed with the company prior to downsizing but that was not involved with innovation, and a group newly hired employees.

Descriptives		Pre-downsizing (t=1)	Post-downsizing (t=2)	
Actors		**241** 3.44 ties on average	**175** (-27.4%) 2.78 ties on average – 66 actors have left the company at this point – 99 actors continue from 2010 – 76 actors newly join the innovation arena	
Total # of ties		**829‡**	**486‡** (-41.4%)	
Innovation dimension		678	430 (-36.6%)	
Formal dimension		750	456 (-39.2%)	
Informal dimension		683	409 (-40.1%)	
Density Avg value *(std dev)*	*Innovation*	0.0148 (0.1989)	*Innovation*	0.0101 (0.1689)
	Formal	0.0212 (0.2655)	*Formal*	0.0131 (0.2089)
	Informal	0.0179 (0.2376)	*Informal*	0.0114 (0.1897)
Reciprocity	*Innovation*	0.1281	*Innovation*	0.1054
	Formal	0.1261	*Formal*	0.0857
	Informal	0.1308	*Informal*	0.0965
Transitivity	*Innovation*	25.05%	*Innovation*	28.69%
	Formal	25.74%	*Formal*	27.94%
	Informal	23.80%	*Informal*	26.24%

Table 7.1: The network descriptives over time

‡ Ties in the formal, informal, and innovation network may not add up to 'total number of ties' because a relation between individuals can combine several dimensions into a multiplex tie (Ibarra 1993).

[24] A common misconception in periods of downsizing is that no new employees are hired. However, as skillsets are reevaluated and new projects due to corporate restructuring are established, new recruits may be required.

All together, the downsizing was followed by a drop of average innovation ties maintained by individuals of almost 28% (3.44 on average prior to and 2.78 on average after the reorganization). The common explanation by those interviewed is pointedly summarized by an employee at the NBD department: *'Under the current climate of short term goals and uncertainty, rowing upstream is not the way to go – further investing in my innovation contacts right now therefore feels like a waste of effort'.*

Contrary to our expectations we only find an increase for the degree of transitivity over time, for each of the three networks included in the study. The other two cohesion measures decline for each of the networks. Sasavova *et al.* (2010) suggest that people have an affective and cognitive preference for transitive structures, but this apparently does not relate to density at network level and does not rely on relations being reciprocal, at least in the short run. Intransitive structures, in which friends of an ego's friend are not necessarily ego's friends as well, might cause anxiety and cognitive strain for people (Heider 1958). Intransitivity might be straining for people in times of downsizing in particular. Reciprocity declines following downsizing, which seems due to the type of employees that left the company. One NBD employee remarked that: *'Several of those who left our company were informally most definitely key players. But they were also bottlenecks, no doubt'*. Gaps opening up in the different networks can be difficult to fill, at least in the short run. The moment at which newcomers enter the organization might additionally explain the drop in reciprocity shortly after the reorganization. A HRM manager observed that *'Newcomers are few, but those that joinedhave a hard time getting involved in the informal organization, this requires time, as in any other company'*. Although further research is needed, several employees suggest that: '*Although the informal organization is also affected, it does not at all seem to be the focus of the downsizing program'.* To which one of the program managers responded: '*We know the informal organization is important, but it is just so hard to really get a hold of. Let's first straighten out the formal side of things and emphasize proper [formal] communication.'* The immediate effects might be challenging, however, as illustrated by the following observation of a Beta Company employee: *'The informal communication has become more chaotic. In the end it is evident that everyone has to fend for himself'.*

The different network cohesion indicators do not suggest increased cohesion as a result of reorganization over time, as was expected. If anything, the opposite seems to happen, which is unexpected. We thus cannot support proposition 1. From an innovation perspective, the decline of network cohesion following downsizing might be beneficial since a densely networked group may also be a group that does not welcome outside information or test their own views against outside information and criteria – a densely networked group may generate fewer new ideas (Obstfeld 2005).

To understand the decline of cohesion in the different networks, we conducted an additional analysis to determine the extent to which ties occur together in a single relation (tie multiplexity) by performing QAP regressions (c.f. Shah 2000; Aalbers *et al.* 2012). The structure of the networks of formal, informal and multiplex relations can be the independent variables explaining the structure of the innovation network as dependent variable, at network level. Even though absolute network size and density decrease, the presence of multiplexity, where several network dimensions combine into one relation, stays robust over time (pre: R^2=0.797, p=.001; post: R^2=0.819, p=.001). The beta estimated for the formal network explaining the innovation network even increases (from 0.534 to 0.697) and the beta of the informal network as dependent variable decreases (from 0.380 to 0.220). Although density declines, tie multiplexity might be an additional indicator that enables innovation ties to sustain under conditions of what might be seen as 'external shock', illustrating the connection between the formal and informal network with the innovation network. Due to the dyadic permutation method that QAP regression involves no estimation of weighted effects between the different models can be generated however, leaving the exact effects in terms of model improvement open for future exploration.

Innovation resilience and control in the formal network

Employees clearly perceive the value of being in the loop of things in the formal network, which the betweenness measure indicates. A marketing employee observes: *'I experience boundaries in my day-to-day work which you don't just cut through now things are uncertain. Getting to know those who matter costs more time and effort. I am quite fortunate to have my formal contacts established and regard them highly'*. Moving on to the quantitative analysis of proposition 2a and 2b, Table 7.2a reports means, standard deviations and correlations. The analysis contains only the

99 employees involved in the innovation community at both t=1 and t=2 to allow for proper comparison.

	Variable (actor level)	Mean	Std. Dev.	1	2	3	4	5	6	7	8
1	Delta innovation ties	-.220	7.822								
2	Tenure	7.399	6.737	.162							
3	Gender	.806	.397	-.090	.021						
4	Department	3.244	1.443	.104	.041	-.078					
5	Hierarchy	4.255	.966	-.112	-.135	-.085	-.104				
6	Value of Input	1.823	2.346	-.120	-.162	-.043	-.359	.131			
7	Density formal t=1	0.308	0.173	-.002	.007	.087	-.071	.014	-.050		
8	Between formal t=1	.001	.004	-.598**	-.019	.117	-.110	-.190*	.077	-.043	
9	BonPower formal t=1	7.229	14.455	-.523**	.159	.178*	-.058	-.103	-.035	-.020	.740**

Table 7.2a: Means, standard deviations and correlations (Formal=IV, Innovation=DV)
*Correlation significant * at 0.05, and ** at 0.01 levels (1 tailed); n=99 employees involved at both t=1 and t=2 in the innovation network.*

Table 7.2b presents the OLS regression outcomes for this proposition[25]. To make sure that the sample size did not lead to a violation of the normality assumption,

[25] In social networks observations are, by definition, not independent. This violates an important assumption that underlies most standard statistical techniques. However, although we know that the independence assumption is violated in social network data, it is generally unknown to what extent this affects parameter estimation and inferences. Over the recent years, advances have been made in the development of statistical analysis techniques well-suited for social network data (most notably ERG-models, Siena, p-star, and QAP), but none of these models are suited for the testing of the specific hypotheses in this chapter. We therefore decided to present results based on the OLS-framework in this chapter, because it allows one to present readily interpretable results. Statistical theory suggests that the parameter estimates in the OLS model are likely to have little bias. The lack of independence of our observations is, however, likely to affect the width of confidence intervals and, as a result, may make inference based on OLS models lack in conservatism. To address this OLS shortcoming, we conducted a bootstrap procedure (Snijders and Borgatti, 1999; Davison and Hinkley, 1997; Efron, 1979; Efron and Tibshirani 1986) to estimate empirical confidence intervals, both parametrically and nonparametrically. In particular, we conducted an m-out-of-n bootstrap (Bickel and Ren 1996; Bickel, Goetze and Zwet

we checked for non-normal distributions and examined the skewness and kurtosis of all the variables. No absolute values greater than one (1) were observed, suggesting normal distributions. Histograms for each variable were examined, again showing no reason to assume violation of the assumption of normality. With VIF scores below 2.5 no indication of multicollinearity was detected either. Additionally, the Durbin-Watson score of 2.104 indicated no autocorrelation in the residuals.

DV	IV: Innovation ties available after downsizing (delta t1 to t2)		
	Model 2a	**Model 2b**	**Model 2c**
Tenure	.138	.117	.155
Gender	-.100	-.037	-.016
Department	.056	-.010	-.008
Hierarchy	-.087	-.217*	-.198*
Value of Input	-.070	-.031	-.046
Density, formal t=1	.007	-.026	-.026
Between, formal t=1	–	-.632***	-.463***
BonPower, formal t=1	–	–	-.225^
N	99	99	99
F-value	.889	9.596***	9.022***
R^2	.055	.427	.448
Adjusted R^2	-.007	.383	.398
F-test for incremental R^2	.	58.468***	3.293^

Table 7.2b: Effects of position in the formal network on innovation resilience
*Standardized coefficients. *** p<0.001, ** p<0.01, * p<0.05, ^ p<0.10.*

1997), based on 10000 resamples, each with a size of 50 percent of the original sample drawn with replacement. The m-out-of-n approach was chosen because it strongly reduces potential dependence effects in the data. Unfortunately, the m-out-of-n approach does tend to make confidence intervals somewhat wider and, consequently, p-values more conservative than necessary. This can be considered a drawback, but it also suggests that any statistically significant result that "survives" the m-out-of-n bootstrap has to be a strong and valid effect. The fact that most of our substantively relevant findings stood up to this bootstrap approach, suggests that these effects are pervasive and are unlikely due to the lack of observation independence in our data.

All the regression results presented in Table 7.2b include the full set of controls. Model 1a is used to test the effect of the controls in isolation, indicating no significant relationship with our dependent variable. Model 2a also includes density as a first network measure based on one's position as an individual. Model 2b then introduces individual betweenness in the formal network indicating one's control of the information and knowledge flow in the extended network. The regression results of model 2b show that betweenness in the formal network Prior to reorganization results in a lower decline of one's ties in the innovation network after downsizing (b=-.632, p<.001). Adding betweenness to the regression model substantially improves model fit (Delta R^2= .390F-test for increased R^2 =58.468, p<0.001). In model 2c betweenness maintains its explanatory value (b=-.463, p<.001); including Bonacich power as measure of individual control over a direct social environment does add to explained variance by the model. The contribution is relatively modest (b=-.225, p<.10) only slightly increasing model fit (Delta R^2=.16; F-test for incremental R^2=3.293, p<0.10).

Innovation ties available after downsizing primarily involve employees who maintained a favorable betweenness position prior to reorganization in the formal network. Employees' (Bonacich) power over information flow in one's direct environment also matters, but far less so. We therefore conclude that it is more important for employees to remain involved with innovation to control the information flow in the extended social environment of the whole network, prior to downsizing, than to control the direct ties they have. We suggest accepting proposition 2a and 2b.

In addition to this, we notably find a significant effect for one's hierarchal position: an employee who is positioned on the corporate ladder is better able to maintain his innovation ties after downsizing, at 1% confidence level, and only after including our control variables. Network Density and particularly Value of Input do not affect outcomes.

Innovation resilience and information control in the informal network

To study the effect of employees' positions prior to reorganization in the informal network on the likelihood that their innovation ties will survive, we first present descriptives (Table 7.3a).

	Variable (actor level)	Mean	Std. Dev.	1	2	3	4	5	6	7	8
1	Delta innovation ties	-.220	7.822								
2	Tenure	7.399	6.737	.162							
3	Gender	.806	.397	-.090	.021						
4	Department	3.244	1.443	.104	.041	-.078					
5	Hierarchy	4.255	.966	-.112	-.135	-.085	-.104				
6	Value of Input	1.823	2.346	-.120	-.162	-.043	-.359	.131			
7	Density Informal t=1	0.104	0.100	-.023	.009	.050	-.159	-.027	.073		
8	Between Informal t=1	.0008	.003	-.558**	.008	.099	-.148	-.210*	.101	-.022	
9	Bonpower Informal t=1	7.454	15.138	-.526**	.126	.176*	-.071	-.119	-.027	-.030	.715**

Table 7.3a: Means, standard deviations, and correlations (Informal=IV, Innovation=DV)
*Correlation significant * at 0.05, and ** at 0.01 levels (1 tailed); n=99 employees involved at **both** t=1 and t=2 in the innovation network.*

Again normality assumptions were tested and no signs of non-normal distribution or multicollinearity were found. VIF scores stayed below 2.5 and tolerance levels above 0.45; Durbin-Watson tests scored 2.082. Table 7.3b then shows the regression outcomes[26]. Model 3a tests the effect of the controls separately, showing no statistically significant relationships of the controls with the dependent variable. Model 3b indicates that a betweenness position in the informal network Prior to reorganization allows one to remain involved with innovation after a reorganization (b=-.606, p<.001). Introducing betweenness position to the model

[26] To rule out any bias due to independence in observations, we conducted a bootstrap procedure identical to the one conducted to validate the OLS outcomes reported in table 7.2b (Snijders and Borgatti, 1999; Davison and Hinkley, 1997; Efron, 1979; Efron and Tibshirani 1986). In particular, we conducted an m-out-of-n bootstrap (Bickel and Ren 1996; Bickel, Goetze and Zwet 1997), based on 10000 resamples, each with a size of 50 percent of the original sample drawn with replacement. In line with the bootstrap validation procedure carried out to validate the OLS outcomes of table 7.2b, this validation of OLS results reported in table 7.3b also suggest the pervasiveness of the identified effects.

results in a substantial improvement of model fit (Delta R^2= .350, F-test for incremental=49.466, p<0.001). Model 3c introduces Bonacich power over direct information flow in the case of the informal network as additional variable. Having a favorable position of control in the informal network prior to downsizing does allow one to remain involved with innovation (b=.22290, p<.01). The beta and statistical significance for this result is lower than for Betweenness. Improvement in model fit is also more modest (Delta R^2=.034; F-test for incremental R^2=5.944; p<0.01). The results of model 2c show that combining high betweenness and high power in the informal network prior to downsizing makes one better able of retaining innovative ties after downsizing. We thus accept proposition 3a and 3b. In line with our findings derived from the formal network, analysis for the informal network also shows that it is more important for employees to control the information flow to their extended social environment, at the network level, prior to downsizing, than to control the flow of information with the people one is more directly related with, to remain involved with innovation.

DV	**IV: Innovation ties available after downsizing (delta t1 to t2)**		
	Model 3a	**Model 3b**	**Model 3c**
Tenure	.138	.136	.169*
Gender	-.099	-.054	-.023
Department	.054	-.034	-.028
Hierarchy	-.087	-.228**	-.208*
Value of Input	-.071	-.018	-.041
Density, informal, t=1	-.008	-.045	-.048
Between, informal, t=1	–	-.606***	-.394***
BonPower informal, t=1	–	–	-.290*
N	99	99	99
F-value	.890	8.235***	8.345***
R^2	0.055	.390	.429
Adjusted R^2	-.007	.343	.377
F-test for incremental R^2		49.466***	5.944**

Table 7.3b: Effects of position in the informal network on innovation resilience
*Standardized coefficients. *** p<0.001, ** p<0.01, * p<0.05.*

One's position in the organization's hierarchy again allows one to remain involved with innovation after reorganization, but this effect is only noticeable statistically when the control variables are included. Only when including the Bonacich power variable in model 3c, it appears that Tenure will prevent one from remaining involved with innovation after reorganization (at 5% confidence level). The other controls have not statistically significant relation with our dependent variable.

7.5 Discussion and conclusions

Our study provides much needed empirical insights into the development of intra-organizational networks over time in times of organizational stress. Corporate restructuring has been studied before (Gulati and Puranaman 2009), but never in a way that systematically compares the situation prior to and after the event. Our study does this, and focuses in particular on the effects of corporate reorganization (downsizing) on the activities in a firm that contribute to its continued ability to compete: innovation. Adopting a social network perspective, this study also is the first to study at the micro level what changes corporate reorganization actually produces.

In a cross-sectional study of a limited number of firms, studied after the reorganization had taken place, Dougherty and Bowman (1995) find that downsizing disrupts an organization's ability to innovate. We show that innovative activities and exchanges are remarkably resilient throughout a downsizing episode. The innovation network does decrease in terms of absolute size, as a considerable amount of employees were made to leave the organization, but remains largely intact and coherent in terms of structural characteristics. Employees do not resort to activities that have an immediate, visible effect to evidence their contribution to the organization.

We hypothesize and find that resilience of ties in the innovation network is due to the control that individuals have over the information and knowledge exchanged in the formal as well as the informal networks in an organization prior to downsizing. Control of such information flows in one's immediate network environment (Bonacich power) is important, but extended control over the flow of information in the full network (Betweenness) is even more important. One way of interpreting this finding is to suggest that awareness of and control over a diverse flow of information that comes with connectedness in a whole network is more

important than of the immediate flows. Yet, Value of Ideas as a variable does not offer statistically significant results. One may also suggest that political positioning and coalition building with immediate contacts may not be helpful at least in making sure one remains involved with innovation. The fact that one's hierarchical position only becomes significant when including the information-control variables is indicative of this.

Given that cohesion in the networks does not substantially increase to produce social groupings of tightly connected individuals who might resist input of new ideas and newcomers (Reagans and McEvily 2003; Gargiulo and Benassi 2000), we suggest that downsizing need not spoil a firm's climate for innovation. Unfavorably positioned in the formal and informal networks stand a bigger chance of not being involved with innovation anymore after a corporate reorganization. These individuals might even have been forced to leave the organization. We do not know if this effect of a reorganization will leave the organization vulnerable to loss of crucial knowledge and experience. An IT employee stated: "*Actually, I do not much miss those who left as one might indeed have expected. The fact of the matter is that I keep on going with the people I knew*." This employee may or may not have the organization's interest in mind in addition to his own. This would need to be studied in subsequent research and is something for management to consider. Individuals who risk being excluded, are more easily identifiable based on the social network approach adopted in this chapter.

Limitations and future research

Our single case study research design can raise questions about the generalization of our findings (Miles and Huberman 1994; Yin 1994). Corporate reorganization and downsizing is among the most important form of radical strategic change for a firm, yet it has not been comprehensively studied so far (Datta *et al.* 2010; Guthrie and Datta 2008; Schmitt *et al.* 2011). If at all studied, the negative impact of downsizing on employees is considered (Burke and Greenglass 2000). The effects on the strategically and competitively important issue of corporate innovativeness has not been studied in depth, however. Some claim these effects are negative (Mellahi and Wilkinson 2008; Amabile and Conti 1999; Dougherty and Bowman 1995), but this study questions that. In this sense, this study is exploratory, and the unique opportunity of the in-depth and extensive data we could collect

justifies the choice for single case study as a research design (Siggelkow 2007). Future research should examine the effect of downsizing on innovation, as exploratory studied here, among a wider variety of companies. A comparison of the effects of downsizing between knowledge intensive companies and less knowledge intensive organizations could be informative. The effects of downsizing could differ by a firm's competitive environment (cf. DeWitt 1998; Cascio 2002), and firm governance style (Perry and Shivdasani 2005). Differing degrees of autonomy for employees might lead to varying effects of a reorganization. Comparing radical and incremental forms of intervention by management will further understanding of the effectiveness of each kind of interventions.

As a final suggestion, for future research and as a suggestion for management planning and executing corporate reorganization, we also believe that more characteristics of survivors might fruitfully be studied. The human costs of downsizing are regularly perceived as substantial for those made redundant (Burke and Greenglass 2000). Yet 'survivors' tend to receive little attention in research and support from management after downsizing (Devine *et al.* 2003). What determines who survives a reorganization might need to be studied more, as well as what determines how survivors will contribute to the organization's strategic objectives after the reorganization. Management pays much attention to the victims of downsizing, who often receive outplacement services and severance payments (Allen 1997; Gandolfi 2006). More attention can be paid to how survivors can be prepared to continue or improve their contribution to reaching corporate objectives. An analysis of the network structures in a firm, prior to and after reorganization, might be able to shed more light on the revitalization of the firm after downsizing.

Chapter 8

Discussion and Conclusions

8.1 Introduction

The research presented in this dissertation is aimed at increasing the understanding of innovative knowledge transfer in intra-organizational networks. It also shows the effects of managerial intervention to improve intra-organizational innovative potential. We have studied the consequences of various intra-organizational network variables, both at the network level (such as overall network cohesion and multiplexity) as well as at the individual level (such as having many cross-unit or cross hierarchical ties or being centrally located) in relation to the firm's ability to foster innovation. We also researched several personal attributes (such as motivation, hierarchical level or tenure) to determine one's involvement with intra-organizational innovative knowledge transfer. In response to recent appeals for more longitudinal insight into the mechanisms that affect network characteristics we also studied the evolution of the intra-organizational network as it progresses through time. This allowed us to study the way in which managerial intervention affects network characteristics related to innovative knowledge transfer. This chapter provides a summary of our research and a discussion on the managerial relevance of the findings. A review of the generalizability and limitations of the results is also presented. Furthermore we address potential directions for future research.

8.2 Summary of the main findings

In line with the main research question we addressed how intra-organizational network antecedents affect innovative knowledge transfer in intra-organizational networks. We investigated several network characteristics in relation to one's involvement with intra-organizational innovative knowledge transfer. We also researched if and how purposeful managerial intervention may affect these particular structural network characteristics at the network-level as well as employee level over time. To achieve this, this research was divided into three parts.

Part I studied the role of multiplexity and of various forms of cross-ties on innovative knowledge transfer at the network and team level. Part II addressed several individual network attributes at the individual level that might be linked to the exchange of innovative knowledge. Then part III introduced the dimension of time as a factor to study the effect of an incremental as well as a radical managerial intervention on intra-organizational networks. The outcome of these three parts contributes to the understanding of the degree to which several structural intra-organizational network elements, that have been identified as critical in general network theory, cater to the transfer of innovative knowledge. As such, we respond to earlier calls for a deeper understanding of such intra-organizational network characteristics in relation to effective knowledge transfer (Szulanski 1996; Carlile 2004). Departing from a number of key network characteristics and their relationship to innovative knowledge transfer, this research adds to our understanding of intra-organizational networks as they progress in time. Part III in particular responds to recent calls that state that the importance of intra-organizational interventions are often emphasized in relation to knowledge transfer, but where the means by which intervention take effect remained unclear (Okhuysen and Bechky 2009). Below we address the key findings for each of the chapters in more detail.

Findings Chapter 2: Multiplexity

Chapter 2 discussed the role of rich ties for innovative knowledge transfer within organizations by investigating the formal workflow, informal and innovative knowledge transfer networks at two separate companies. The study was driven by several innovation studies that have emphasized the informal contacts in organizations as the main or even only conduit for transfer of innovative knowledge (Borgatti and Foster 2003; Rizova 2007; Foss *et al.* 2010; Gulati and Puranam 2009). We find,

however, that formal network contacts also contribute substantially to innovative knowledge transfer. Additionally we find that the multiplex combination of a formal tie and an informal tie contributes to knowledge transfer beyond the effect of either in isolation. Such multiplex, or, as named in this dissertation, rich ties are found to have a particularly strong effect on innovative knowledge transfer in an organization. That knowledge transfer previously attributed to informal or formal networks only, may in fact be due to these multiplex, or rich, ties. It is these rich ties that we find to contribute substantially to a firm's innovativeness.

Findings Chapter 3: Bridging horizontal and vertical boundaries

In chapter 3 we examined the role of cross-hierarchy and cross-unit ties for innovative project teams. As we explored the innovation network at a large financial services company, we distinguished between vertical cross-hierarchy and horizontal cross-unit ties, a distinction that appeared to be largely ignored in prior research. We argued that both types of ties support team performance, but in distinct ways. We showed that horizontal cross-unit ties provide teams with a diversity of input, whereas vertical ties to higher levels in the organization provide teams with managerial support and resources. The distinct benefits of each type make it hard to substitute one for the other. Successful innovation project teams entertain a much larger number of cross-unit horizontal ties as well as a larger number of cross-hierarchical vertical ties compared to less successful innovation teams. Furthermore, in a case study combining quantitative and qualitative data, we investigated the effect of concentrating horizontal cross-unit and vertical cross-hierarchy ties among a small number of team members versus situations in which these ties are maintained by a large set of team members. Also did we find empirical evidence that successful teams concentrate these horizontal and vertical cross-ties among a few team members.

Findings Chapter 4: Individual motivation

In chapter 4 we looked at the motivational attributes of network members. We integrated the structural network characteristics known to be implicated in the social network literature as critical to knowledge transfer with two motivational perspectives commonly identified in the organization literature. Analyzing data from a survey at a large European engineering multinational and at a large European financial service firm, this study, counter-intuitively, showed that intrinsic motivation

does not explain an individual's favorable position in a knowledge transfer network. Contrary to expectation, extrinsic motivation is not conducive to closeness centrality and neither does this motivational form stimulate inter-unit knowledge transfer. Sheer number of relations predicts inter-unit knowledge transfer. These findings underpin recent appeals for further research on the influence of structural social network characteristics in organization research. It also provides strategic guidance for intra-organizational structural compositions by means of innovation policy, directed at the individual level.

Findings Chapter 5: Network brokering roles

In chapter 5 we focused on the different roles individuals fulfill within the innovation network. The research showed that by understanding the roles of two types of innovation brokers – 'idea scouts' and 'idea connectors' – in the innovation process and by utilizing their talents effectively, managers can preside over major improvements in the conversion of external knowledge into innovative outcomes. To examine this process, we interviewed over 80 innovation brokers at several leading companies in a variety of industries. Thus we gained a deeper appreciation of their attributes and the roles they perform. Moreover we took measures of personal innovation and correlated them with network position, sources of knowledge used and personal factors such as tenure and area of expertise. We found evidence for coordinated brokerage activities as engine for successful open innovation. Additionally we found that by virtue of their pivotal brokering position in the innovation network, a small number of people are most influential in diffusing opportunities for innovation.

Findings Chapter 6: Formal intervention

Chapter 6 studied the effects of a 'simple formal intervention' by management to boost involvement of individual employees with innovation at a large European financial service firm. An individual's position in an organizational innovation network and in particular number and diversity of ties maintained, are known to induce innovative performance. Studying the first of two longitudinal datasets included in this dissertation we combined quantitative and qualitative analyses in a multi method study. We found that intervention favorably impacts these characteristics of individuals in the innovation network. Innovative contacts indeed

can substantially increase due to a 'simple formal intervention' and surge in particular among employees that are not primarily focused on innovation. In addition we showed that formal intervention stimulates newcomers to enter the innovation arena. We also found that newly formed innovative ties are likely to be formed on a multiplex foundation of previously established formal and informal relationships.

Findings Chapter 7: Corporate downsizing

We studied the resilience of the innovation network following corporate downsizing from a longitudinal perspective. Our research commenced once more at a large European financial service firm, this time on a new set of data collected in the years that followed after the input for chapter 6 was finalized. In this research on the effect of corporate downsizing we found that this form of organizational pruning surprisingly did not disrupt some of the organizational network characteristics that have been identified in earlier research as critical to innovative organizational activity. Studying our second longitudinal dataset, our results show that surviving innovation ties remain strongly multiplex in nature, building forth on the benefits of the formal and informal organization for sustained innovative activity. Furthermore, innovation ties available to employees that maintain a central (betweenness) position in the formal-workflow network prior to downsizing prove most resilient to corporate reorganization. We find a similar effect for the informal network. The potential to exercise power or influence over others in the formal-workflow and informal network prior to downsizing is also identified as a predictor of the maintenance of innovation ties directly after downsizing. Employees combining both positions in the informal network prior to downsizing are particularly likely to retain innovative ties post downsizing. Also do we find that one's position on the corporate ladder influences one's capacity to retain innovative ties directly following downsizing. Variance in individual network density prior to downsizing does not affect these outcomes. These insights appear relevant to further the understanding of restructuring the formal and informal organization without losing corporate innovative potential.

8.3 Contribution to the literature

This research contributes to the existing literature on intra-organizational network theory as well as the study of organizational change in a number of distinct ways.

The first contribution is the unique focus on the innovative behavior of individuals within an intra-organizational context. Prior intra-organizational network research commonly focuses on the overall innovation community, leaving out those attributes at the individual level that might help organization researchers in furthering the understanding on how to influence the innovative organization. As we address both structural as well as psychological attributes at the individual level, we provide empirical data that might be of help in determining which variables might prove useful to better understand the flow (or lack thereof) of innovative knowledge.

Our second contribution comes from our assertion of the importance of multiplex ties in an intra-organizational setting. Although research in different settings has found that ties that combine multiple dimensions of a relation can have a substantial and qualitatively different effect from the effects of their constituting elements (Burt 1984; Smith-Doerr *et al.* 2004), these findings had not been empirically validated with respect to intra-organizational innovative knowledge transfer. This finding also fits well in a dynamic firm capability perspective, as we address a critical dimension for organizations to sustain competitive advantage in a turbulent environment (cf. Janssen *et al.* 2006).

Our findings on the role of vertical and horizontal cross-ties offer new insights to organizational network theory on team structures as well as New Business Development literature, constituting our third theoretical contribution. As pointed out in chapter 3, with the notable exception of Ancona and Caldwell (1992), the effect of team members spanning boundaries on team innovative performance is largely ignored (cf. Marrone *et al.* 2007). We explicitly distinguish between horizontal ties crossing organizational unit-boundaries and vertical ties crossing hierarchical boundaries and provide the first exploratory empirical evidence for the distinct benefits of each type of cross-tie. As such we provide a further clarification to what might be described as a somewhat opaque view of the concept of cross-ties in both fields. What is more, our network approach shows that innovative activity spans across many borders, both functional as well as hierarchical. Being able to effectively

organize these cross-ties appears to distinct successful project teams from the less successful ones. This is a finding by itself, which adds to the literature on NBD team performance. While literature (e.g., Hansen 2002) assumes that team members can and will access horizontal and vertical cross-ties when needed, our findings suggest that this may not be evident per se. Project teams that perform well have more cross-ties in general and vertical cross-ties in particular. However, these cross-ties should be concentrated in the hands of a few team members (cf. Hansen 2002) and be a specialized job for some team members. To unsuccessful teams an important reason for lagging performance appeared to be, unlike what Ancona and Caldwell (1992b) imply, that these teams were unable to implement a proper strategy to orchestrate their ties effectively. This is resulting in inefficiencies and frustration for both team members and management.

Our observations on two distinct types of formal intervention form the fourth major contribution of this dissertation. As such, this study responds to recent calls in organizational theory to further insight in the way interventions take effect within an organization (Okhuysen and Bechky 2009). Our findings might prove helpful in determining how to purposefully and selectively intervene in innovative intra-organizational networks. They also provide empirical example of the effects on the catalyzing of tie formation as well as of tie decline. We provide in-depth insight in the effect of a formal intervention by management and its effect on the exchange of knowledge on several relational dimensions (Chapter 6). Moreover, we follow up earlier research by Shah (2000), as we shed light on the network effects of downsizing by means of a multi-method study, which is particularly rare in this line of research to date (Chapter 7). These findings might prove useful to start up much needed studies on tie formation strategies (Hallen and Eisenhardt 2011) which, at the intra-organizational level, have not been carried out to date.

As we add a longitudinal perspective to intra-organizational network research, we also provide a methodological contribution to the field of intra-organizational research. Although the explicit desire to investigate network evolution is not a recent one (Burt 2000; McPherson *et al.* 2001) it only recently has found its way towards the field of organizational network studies (Van de Bunt *et al.* 2005). By means of both studies that form part 3 of this dissertation we respond to this appeal and offer two in depth case studies, based on what commonly is seen as hard to collect proprietary data. Moreover, the multi-method approach we adopt throughout

this dissertation provides the contextual data to network characteristics such as multiplexity and network power at the individual level that have not received much intra-organizational attention in the organizational and network literature to date.

8.4 Managerial relevance

There are several elements addressed in this study that are of managerial relevance, not in the last place as this study is framed in an intra-organizational setting and centers around corporate innovation, a theme regularly claimed to be one of management's prime strategic objectives (Christensen 1997; Dyer *et al.* 2011).

We showed that intra-organizational networks can be structurally analyzed by focusing on a number of variables that are intuitive to management in terms of their relevance for (project) success, yet have remained difficult to make transparent and concrete[27]. Additionally we showed under various organizational conditions, varying from growth aspired, incremental conditions that characterize a typical formal managerial intervention to a more radical form of organization restructuring during downsizing, network structure indeed can be altered without per definition harming elements that are of value to innovative knowledge transfer. Hence, we believe that this study might inspire management to develop intervention strategies that do not dislocate the innovative capacity of the firm. Below we discuss three specific managerial implications of this research that each might contribute to this objective.

Controlling innovative knowledge flows

In various chapters we have pointed out the importance of diversity to innovation. Managers can preside over major improvements in the conversion of external knowledge into innovative outcomes, when they understand the relevance of sufficient brokerage activity to foster diversity. Each chapter however, showed in various ways that generating diversity and sparking new ideas as a means to foster innovation must be viewed upon as a social process that spans across multiple employees. Empirically we have shown the potential impact of those employees who

[27] Such as the presence of hierarchical, multiplex or diverse contacts and the informal positions of control as fulfilled by employees.

are controlling the flow of information by fulfilling brokering positions. They are on the shortest path of formal and informal knowledge flows or even control particular formal or informal resources. This impact might be put to effective use in shielding the innovation network from decay and in realizing innovation resilience in times of turmoil. But potentially it might also disrupt managerial action with regard to innovation if ignored or taken for granted. Also did we show the positive effects that newcomers might have on the innovation network. Managers should be aware of the extended effect of an individual's position on the overall network. Thus they might want to specifically focus or even invest in these dominant actors and the relationships between management and these actors to reduce the risk of bottlenecks and ensure an efficient flow of innovative knowledge.

Organizing successful innovation teams

Purposeful formation of project teams increases the probability of achieving successful innovation outcomes. Our findings are particularly relevant to team formation and to ensure successful functioning of innovative project teams, especially in terms of assigning clear team roles. Horizontal and vertical cross-ties serve different purposes. Our results have shown that taking care of vertical cross-ties in an innovative project team is particularly important to secure project buy-in and legitimacy and to gain managerial attention and secure resources. We argued that this type of ties should be maintained by multiple, but few, team members. These vertical cross-ties are crucial. Management should be reluctant of conversing with a fairly large set of members of a team, as we found it to be an attribute of the lower performing teams in our study. Management should also stimulate the diversity of resources available to a team.

Monitoring

The intra-organizational network methodology deployed in this dissertation can be relatively easily transferred into an approach that might equip management with the means to monitor the effect of their own or external managerial actions on the innovative activity within the organization. By using the intra-organizational network methods, as displayed in various forms throughout this dissertation, managers gain a bird's-eye view of existing network structures and communication patterns that facilitate the innovative activity within the organization. This might

raise awareness of potential risks with regard to the innovative capacity, such as dependencies or underutilized potential, which could be input for more directed managerial action. A board member of one of the companies studied was very clear on this matter as he argued that: *"No manager can truly see or hear everything that is going on at the shop floor. But being able to identify these resources that are most likely to be in the midst of things with regard to innovative activity, will really help in not losing touch with what might very well shape the future of our company."*

8.5 Generalizability and limitations

Although intra-organizational network research still might be described scientifically as underdeveloped, at the same time we believe that network theory can truly help to enhance our comprehension of organizational behavior. We also believe that this study contributes to this objective by exploring some of the much needed empirical in-depth network data and by pointing out several factors that contribute to the effective transfer of innovative knowledge. Yet, we are well aware that our study has various limitations, aside from the specific limitations addressed in each of the six studies described in this dissertation.

In the first place, we have only studied a limited number of firms. Where the majority of the chapters are based on one or two in depth case-studies this might lead to questions concerning generalizability of our findings. While this approach may surprise scholars not familiar with social network analysis, for social network analysts this is known not to be problematic (Cross and Cummings 2004). Furthermore, Chapter 5 has been an exception to this approach and has results based on a truly plural number of companies. The particular findings presented in this chapter however, proved to be highly similar among the companies studied, which might suggest that the point of restricted generalizability maybe also should not be over-emphasized.

A second limitation comes from the intra-organizational focus adapted in each of our studies. As alliances and other forms of network consortia are more and more coming to the fore in business life today, focusing on the employees that work within the physical boundaries of a firm might be leaving out other entrepreneurial, but also workflow or informal related, knowledge sharing. Due to the methodological

constraints that come with collecting robust network data as well as the derived response rates required, this is a limitation that is hard to tackle.

8.6 Directions for future research

As we come to the concluding of this dissertation, we address a number of ideas for future research that entail both the disciplines of organizational, innovation and network research.

Data collection

Social network data has proven to be rather difficult to collect, for instance because high response rates are imperative (Doreian and Stokman 2005). As a result framing a longitudinal research design requires long-term commitment by both the company under investigation as well as perseverance by the research population and by the researcher. Successfully tackling this research hurdle makes for interesting research input. However, future research could benefit from the inclusion of email data as an alternative or secondary data source. Social network research on email data is still in its infancy, but has recently started to receive considerable attention (Kossinets and Watts 2006). Some of the main benefits include the ability to trace back longitudinal network developments in time, without having to actually incorporate the same timeline in one's research planning. This might prove particularly beneficial when researching the effects of specific effects in time, such as managerial interventions or even external 'shock effects'. Additionally potential difficulties in generating commitment to partake in the research become more of a managerial matter and no longer an affair that can be frustrated at the shop-floor as is the case in traditional organizational social network studies. Also might this type of data collection further rule out data bias based on socially desirable answers. We also see benefits of including content analysis as a means to include sentiment, content and reciprocal effects in one's study design.

Nevertheless we firmly believe that email data cannot be a substitute for actual social network data collected based on the direct input by the population at hand. There have been studies that point out that the majority of exchange of truly new knowledge takes place in face-to-face interaction and the discrepancy between the interpretation of one's true intentions also has proven to be much more difficult

to judge based on email transfer than on social interaction. Intra-organizational network researchers have recently started to point out noticeable differences between social and email data. While social networks reporting face-to-face interaction are strongly shaped by gender, tenure and hierarchical boundaries, the role of these boundaries appears much weaker in email network (Lex *et al.* 2011). We therefore advise future research to treat email data as a supplement to more traditional means of data collection.

Firm boundary spanning

Outside the scope of this dissertation, but worth investigating is the interaction of the organizational innovation network with actors outside the traditional boundaries of the firm. Where this dissertation particularly addressed the role of cross unit and cross hierarchical ties as a means to secure diversity and commitment to ideas, similar effects have been related to the spanning of the organizational boundary (Hansen 1999), a development briefly touched upon in our discussion of the idea scout in chapter 5. This type of external interaction is, we believe, rather common and picking up interest at the higher organizational echelons too. Recent organizational developments, coined the networked organization, web 2.0 or the new way of working, will only add to this effect and require a better understanding concerning their effect on intra-organizational network dynamics. One could for instance argue that increased interaction outside the formal perimeters of the organization might result in a shift in power within the organization as alternatives for knowledge and insights increase and dependency on certain peers may reduce. Applying a multilevel perspective in terms of relations (Brass *et al.* 2004) might prove to be a fruitful avenue for future research in this respect.

Another interesting line of future research might be the studying of the governance required to orchestrate such inter-organizational social networks. We argue that innovation networks that are not to be confused with more traditional forms of alliances that are commonly based on rather selective inter-organizational interaction at board level or on the level of dedicated research- or project-teams.

Additionally our findings in chapter 3 that identify the organization of cross-ties as distinctive between successful project teams and less successful ones, might also shed new light on the already extensively researched idea of cross boundary brokerage or gatekeeping. Future research might look into our proposition that

brokering across vertical or horizontal borders might require different traits of a broker, examples of which are provided in this study.

Newcomer socialization

Another relatively uncharted theory of intra-organizational network research is the effect of newcomers. Although newcomer socialization has been gaining in interest in the recent years from a social psychology perspective on group processes (e.g., Levine and Choi 2010; Hansen and Levin 2009), the exact longitudinal effects of newcomers still remain underexplored. Where earlier research has particularly focused on reputational effects of newcomers entering the innovation arena (Moreland and Levine 2002), we pose that the actual network characteristics of this arena to be entered require further attention to better understand the options available to a newcomer in affiliating itself and entrenching itself in the various network forms that have been addressed in this dissertation. This might require a longitudinal research setup and insight in the overall network population in a way as we have realized in part III of this dissertation.

Information processing

On a more speculative note, our research might suggest a more nuanced view on the classical information processing ability of an organization (March and Simon 1958). Were information processing capacity under uncertain circumstances, conditions typical to innovation, has been ascribed as primarily directed by (top) management (Shim and Lee 2001; Tourish and Pinnington 2002), it might be that the actual innovative capacity of an organization is more of a distributed phenomenon, composed of many actors without direct formal governance and direction. Being able to effectively tap into this network is what might distinct successful innovation leaders from others. The information processing capacity of networks requires more profound insights into the specific context in which the information processing takes place (Feldman and March 2003), and might even benefit from experimental settings in which social network structures are purposefully altered to assess what network characteristics enhance processing efficiency.

8.7 Concluding remarks

In conclusion, this dissertation contributes to innovation, organizational and network research and practice, by exploring the effect of various network antecedents on the innovative knowledge transfer in intra-organizational networks. Additionally it addressed how formal managerial intervention affects the employee's structural network characteristics in the innovation network. This increased understanding can benefit both organizational scholars as management practitioners alike. In closing, the insights rendered from the observation of the various organizational networks addressed in this dissertation above all reinforce the awareness that also under corporate conditions it is through cooperation rather than conflict that eventually the greatest successes will be derived.

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Summary

The central objective of this dissertation is to explore the relation between both formal and informal human collaboration within organizations from an intra-organizational network perspective. We elaborate on the reasons as to why these networks might be seen as a viable path to structure for innovation. This dissertation focuses on the network behavior of individuals as they position themselves in the wider organizational innovation arena. Much of the prior research on innovation has emphasized the role of the innovation community as an entity of its own. We on the other hand particularly articulate the behavior and network antecedents displayed at the individual level in relation to innovative activity. In doing so an answer is provided to the question of what characteristics determine an employee's involvement with intra-organizational innovative knowledge transfer. In response to recent appeals for more longitudinal insight in the mechanisms that affect network characteristics this dissertation also addresses the evolution of these intra-organizational networks as they progress in time. More specifically we examine the way in which managerial intervention in these networks might affect intra-organizational innovative potential over time. As such, this dissertation is nested in what is formally defined as network theory, examining the mechanisms and processes that interact with network structures to yield particular outcomes for individuals and groups (Borgatti and Halgin 2011).While the benefits of intra-organizational network structure have received considerable attention in the network and innovation literature, the way in which innovative knowledge is transferred in intra-organizational networks are less well understood and the multiplex nature of these networks is often disregarded.

Part I of this dissertation studies the role of multiplexity and of various forms of cross-ties on innovative knowledge transfer at the network and team level. The study was driven by several innovation studies that have emphasized the informal contacts in organizations as the main or even only conduit for transfer of innovative

knowledge (Borgatti and Foster 2003; Rizova 2007; Foss *et al.* 2010; Gulati and Puranam 2009). We find, however, that formal network contacts also contribute substantially to innovative knowledge transfer. Additionally we find that the multiplex combination of a formal tie and an informal tie contributes to knowledge transfer beyond the effect of either in isolation. Such multiplex, or, as named in this dissertation, rich ties are found to have a particularly strong effect on innovative knowledge transfer in an organization. Knowledge transfer previously attributed to informal or formal networks only, may in fact be due to these multiplex, or rich, ties. It is these rich ties that we find to contribute substantially to a firm's innovativeness.

The role of cross-hierarchy and cross-unit ties for innovative project teams is then further examined. We show that both vertical cross-hierarchy and horizontal cross-unit ties support team performance, but in distinct ways. Horizontal cross-unit ties provide teams with a diversity of input, whereas vertical ties to higher levels in the organization provide teams with managerial support and resources. The distinct benefits of each type make it hard to substitute one for the other. Successful innovation project teams entertain a much larger number of cross-unit horizontal ties as well as a larger number of cross-hierarchical vertical ties compared to less successful innovation teams. Empirical evidence is provided that confirms successful teams to concentrate these horizontal and vertical cross-ties among a few team members.

Next, part II of this dissertation addresses several individual network attributes that might be linked to the exchange of innovative knowledge at the individual network level. Analyzing data collected at two separate innovative organizations, this dissertation, counter-intuitively, shows that intrinsic motivation does not explain an individual's favorable position in a knowledge transfer network. Contrary to expectation, extrinsic motivation is not conducive to closeness centrality and neither does this motivational form stimulate inter-unit knowledge transfer. Sheer number of relations predicts inter-unit knowledge transfer. These findings underpin recent appeals for further research on the influence of structural social network characteristics in organization research. They also provide strategic guidance for intra-organizational structural compositions by means of innovation policy directed at the individual level.

Subsequently we address the different roles individuals fulfill within the intra-organizational innovation network when including a view that extends beyond

the organization's boundaries. We find evidence for coordinated brokerage activities as engine for successful open innovation. Our research shows that by understanding the roles of two types of innovation brokers – 'idea scouts' and 'idea connectors' – and by utilizing their talents, managers can preside over major improvements in the conversion of external knowledge into innovative outcomes. Additionally we find that by virtue of their pivotal brokering position in the innovation network, a small number of employees are most influential in diffusing opportunities for innovation.

Part III introduces the dimension of time as a factor to study the effects of an incremental and a radical managerial intervention on intra-organizational networks. Studying the first of two longitudinal datasets, we combined quantitative and qualitative analyses in a multi method study. This set-up allows for the studying of the effects of a 'simple formal intervention' by management to boost involvement of individual employees with innovation at a large European financial service firm. An individual's position in an organizational innovation network, and in particular the number and diversity of ties maintained by the individual, are known to induce innovative performance. We find that the intervention favorably impacts these characteristics of individuals in the innovation network. The number of innovative contacts can substantially increase due to a 'simple formal intervention' and surge in particular among employees that are not primarily focused on innovation. In addition we show that formal intervention stimulates newcomers to enter the innovation arena. We also find that newly formed innovative ties are likely to be formed on a multiplex foundation of previously established formal and informal relationships.

Analyzing a second longitudinal dataset, we move on to explore the resilience of the innovation network following corporate downsizing. We find that this form of organizational pruning surprisingly does not disrupt some of the organizational network characteristics that have been identified in earlier research as critical to innovative organizational activity. The surviving innovation ties remain strongly multiplex in nature, building forth on the benefits of the formal and informal organization for sustained innovative activity. Furthermore, innovation ties available to employees that maintain a central (betweenness) position in the formal workflow network prior to downsizing prove most resilient to corporate reorganization. We find a similar effect for the informal network. The potential to exercise power or influence over others in the formal workflow and informal network prior to downsizing is also identified as a predictor of the maintenance of innovation ties directly after

downsizing. Employees combining both positions in the informal network prior to downsizing are particularly likely to retain innovative ties post downsizing. Also do we find that one's position on the corporate ladder influences the capacity to retain innovative ties directly following downsizing. These insights appear relevant to further the understanding of restructuring the formal and informal organization without losing corporate innovative potential.

Overall, this dissertation contributes to a network based view on intra-organizational cooperation as it identified a number of insights that allow for effective managerial intervention to spur corporate innovation. The insights above all highlight that also under corporate conditions it is through cooperation rather than conflict that eventually the greatest successes will be derived.

Samenvatting (Dutch summary)

Dit proefschrift adresseert de relatie tussen de formele en informele menselijke samenwerking binnen organisaties vanuit een intra-organisatie netwerk perspectief. Het verkent de wijze waarop deze netwerken het structureren van intra-organisationele innovatie toelaten. Veel van het eerdere onderzoek naar innovatie benadrukt de rol van de innovatie-gemeenschap als een entiteit op zich. Dit onderzoek richt zich echter specifiek op het gedrag en de netwerk antecedenten op het niveau van het individu, in relatie tot innovatieve activiteiten. Als zodanig verschaffen we inzicht in de kenmerken die bepalend zijn voor individuele betrokkenheid bij intra-organisationele innovatieve kennisoverdracht. In reactie op recente oproepen tot longitudinaal onderzoek naar de mechanismen die van invloed zijn op de evolutie van deze intra-organisatie netwerken hanteren we in dit onderzoek zowel een cross-sectionele als longitudinale insteek. Meer specifiek bekijken we de wijze waarop bestuurlijke interventie verschillende intra-organisatie netwerken kan beïnvloeden, en via die weg het innovatie potentieel van een organisatie vormgeeft. Als zodanig is dit proefschrift genesteld in organisatie netwerk theorie, het onderzoek van organisatorische mechanismen en processen in relatie tot netwerkstructuur, met als doel het genereren van specifieke uitkomsten voor individuen en groepen (Borgatti en Halgin 2011).

Hoewel de voordelen van de intra-organisationele netwerkstructuur aanzienlijke aandacht heeft ontvangen binnen de recente netwerk- en innovatie literatuur, is de manier waarop innovatieve kennis wordt overgedragen binnen deze intra-organisatie netwerken minder uitgekristalliseerd. Daarbij wordt ook de multiplexe aard van dergelijke netwerken veelal buiten beschouwing gelaten. Deel I van dit proefschrift bestudeert de rol van multiplexiteit en van verschillende vormen van cross-ties op innovatieve kennisoverdracht op netwerk- en teamniveau. De studie is gedreven door eerder onderzoek dat de informele contacten in organisaties

benadrukt als het belangrijkste, of zelfs het enige kanaal, voor de overdracht van innovatieve kennis (Borgatti en Foster 2003; Rizova 2007; Foss et al., 2010; Gulati en Puranam 2009). Dit proefschrift toont echter dat de formele netwerkcontacten ook aanzienlijk bijdragen aan innovatieve kennis overdracht. Daarnaast vinden we dat in het bijzonder de multiplexe combinatie van een formele relatie en een informele relatie bijdraagt aan innovatieve kennisoverdracht, buiten het effect van elk van dit type relaties in isolatie.

Vervolgens onderzoeken we de rol van cross-hiërarchische en cross-unit relaties in relatie tot het succes van innovatieve projectteams binnen een organisatie. We laten zien dat zowel verticale, cross-hiërarchische als horizontale cross-unit relaties team prestaties ondersteunen, maar op verschillende wijzen. Horizontale cross-unit relaties bieden teams een diversiteit aan input, terwijl verticale relaties naar hogere hierarchische niveaus binnen een organisatie teams voorzien van leidinggevende ondersteuning en toegang tot schaarse resources. De duidelijke voordelen van elk type relatie maken het moeilijk om de één te vervangen door de ander. Succesvolle innovatie project teams onderhouden een aanzienlijk groter aantal cross-unit horizontale relaties en een groter aantal cross-hiërarchische verticale relaties in vergelijking met minder succesvolle innovatie teams. Dit proefschrift levert empirisch bewijs dat succesvolle teams het onderhouden van dergelijke horizontale en verticale relaties concentreren bij een select aantal teamleden.

Deel II richt zich op verschillende netwerk attributen op individueel netwerkniveau die te relateren zijn aan de uitwisseling van innovatieve kennis. Analyse van data, verzameld bij twee afzonderlijke innovatieve organisaties, toont contra-intuïtief dat de intrinsieke motivatie van de individuele medewerker niet bepalend is voor een gunstige positie binnen het intra-organisatie innovatienetwerk. In tegenstelling tot de verwachting, is ook extrinsieke motivatie niet voorwaardelijk voor een centrale positie van het individu binnen dit netwerk. Geen van beide motivatievormen stimuleert significant de kennisoverdracht tussen organisatie-units, maar juist het absoluut aantal relaties dat door het individu wordt onderhouden voorspelt kennisoverdracht tussen units. Deze bevindingen beantwoorden aan de oproep voor verder onderzoek naar de invloed van structurele sociale netwerk kenmerken binnen organisaties en geven handvatten voor intra-organisatorisch innovatiebeleid.

Vervolgens wordt ingegaan op de verschillende rollen die individuele medewerkers kunnen vervullen binnen het innovatie netwerk van hun organisatie. We vinden bewijs voor de relevantie van gecoördineerde brokerage-activiteiten als motor voor succesvolle open innovatie. Ons onderzoek toont aan dat door het begrijpen en benutten van de rol van twee soorten innovatie makelaars, de 'idee scouts' en 'idee connectors', managers belangrijke verbeteringen binnen het intra-organisationele innovatie proces kunnen realiseren. Daarnaast vinden we dat uit hoofde van hun brokering positie binnen het innovatie netwerk, een klein aantal werknemers het meest invloedrijk zijn wat betreft verspreiding van mogelijkheden voor innovatie die gedreven is door ontwikkelingen van buiten de organisatie.

Deel III introduceert de dimensie van de tijd als factor om het effect van een incrementele en radicale interventie op de verschillende intra-organisatie netwerken te bestuderen. Analyse van de eerste van twee longitudinale datasets onderzoekt het effect van een 'eenvoudige formele interventie' door het management op de betrokkenheid van de individuele medewerkers bij innovatie. Een individu's positie binnen het innovatie netwerk en in het bijzonder het aantal en de diversiteit van de onderhouden relaties, zijn bekende variabelen voor het positief beïnvloeden van de innovatieve prestaties van individu en organisatie. Dit proefschrift toont dat een incrementele interventie deze individuele kenmerken binnen het innovatienetwerk over de tijd heen positief kan beïnvloeden. Het effect van een dergelijke 'eenvoudige formele interventie' is met name positief onder werknemers die zich in hun dagelijkse activiteiten niet primair richten op innovatie. Verder stimuleert een dergelijke interventie ook nieuwkomers om de innovatie arena te betreden. Aanvullend tonen we aan dat deze nieuw gevormde innovatieve relaties veelal een multiplexe basis in de vorm van al eerder aanwezige formele en informele betrekkingen hebben.

Analyse van de tweede longitudinale dataset kijkt vervolgens naar de veerkracht van het innovatienetwerk in navolging van een reorganisatie. Verrassend stellen we vast dat een groot deel van de netwerk eigenschappen die in eerder onderzoek zijn geïdentificeerd als essentieel voor het innoverend vermogen van een organisatie, niet per definitie verstoord worden in de nasleep van een reorganisatie. Relaties binnen het innovatienetwerk die de reorganisatie overleven, blijken veelal een multiplex fundament te hebben voorafgaand aan de interventie. Deze relaties profiteren van de voordelen die de formele en informele netwerken pre-reorganisatie met zich meebrengen en vormen de basis voor duurzame innovatieve activiteit.

Verder blijkt dat relaties in het innovatie netwerk het meest bestand zijn tegen het effect van een reorganisatie in geval deze worden onderhouden door medewerkers met een sterke centrale (betweenness) positie in het formele workflow netwerk voorafgaand aan de reorganisatie. We treffen een vergelijkbaar effect aan binnen het informele netwerk. Het potentieel om macht of invloed over anderen uit te oefenen in het formele-workflow en informele netwerk voorafgaand aan een organisationele inkrimping wordt ook gezien als een voorspeller van het behoud van innovatie banden. Werknemers die beide posities in het informele netwerk voorafgaand aan de inkrimping weten te combineren, zijn in het bijzonder geschikt om innovatieve relaties te behouden in navolging van een reorganisatie. Ook vinden we dat een individu's positie op de organisatie ladder het individuele vermogen om innovatieve banden direct na een reorganisatie te behouden beïnvloedt.

In de bredere zin draagt dit proefschrift bij aan een network-based-view op intra-organisationele samenwerking. Het verrichte onderzoek verschaft een aantal inzichten welke gerichte bestuurlijke interventie mogelijk maken ter bevordering van intra-organisationele innovatie. Deze inzichten zijn tevens relevant voor begripsontwikkeling rond de herstructurering van de formele en informele organisatie in tijden van zowel organisationele voor- als tegenspoed, zonder verlies van het innovatief organisatie potentieel. De gepresenteerde inzichten benadrukken dat ook binnen organisaties geldt dat door middel van samenwerking in plaats van conflict uiteindelijk de grootste successen behaald kunnen worden.

Acknowledgements

Having been exposed to a variety of organizational settings during my early studies and consulting work, it was four years ago that I was struck by the implicit elegance of human cooperation as a principal and potentially unlimited source for organizational innovative attainment. Although the simplicity of the idea appealed to me, the challenges of successfully organizing intra-organizational networks for innovation can be vast, as I had witnessed first-hand.

Venturing into the scientific fields of the modern organization, innovation and human cooperation to better understand these fundamental organizational challenges, not only provided me with new insights, but also resulted in a greatly fascinating and fulfilling journey. It has been a great way to get in touch with several enthusiastic and bright people who have motivated me to go the extra mile and with whom I share a similar curiosity for the unknown. On a personal note and in the first place I owe great debt to my wife Angela for her resilience and involvement throughout the past four years. I also would like to thank my parents and brother for their endless encouragements.

In particular I would like to thank Wilfred Dolfsma of Groningen University for his outstanding mentoring and support. As once said by the jazz-musician Charles Mingus, anyone can make the simple complicated – however, true creativity is making the complicated simple. Wilfred, not only do I regard you as unquestionably creative, your enthusiasm and endless ability to reflect upon the ideas that condensed into this dissertation also have been truly inspiring to me. In addition I am also very grateful to Roger Leenders of Tilburg University and Otto Koppius of Erasmus University for their academic thoroughness and quantitative rigor throughout the course of my research. Both of you indisputably encouraged me to step it up.

In addition I would like to extend my gratitude to the members of this dissertation's reading committee, Professors Gerben van der Vegt, Frans Stokman

and Julian Birkinshaw. I am thankful for the time you have taken to review my work and for providing me with a number of constructive comments.

I am also grateful for the support I received from the various institutions that I visited during my studies and the organizations that were so kind to grant me insight into their daily routines and strategic aspirations, serving as valuable case studies to me. I especially would like to thank Dave Rietveld and Hans Hellendoorn who were of great help in showing me the many aspects of new business development and innovation from the trenches of corporate life.

I have appreciated the fruitful cooperation and discussions with many others as well, including Frank Korf, Sander Smit, Eoin Whelan, Eric Lim, Charlie Carroll, Jasper de Valk, Salvatore Parise, Thomas Allen, David Dekker, Florian Noseleit, Tom Davenport and Hans van der Beij. Also the constructive comments on earlier concepts of various parts of this dissertation by participants of the 2012 Academy of Management Conference, the 2012 Organization Science Winter Conference, DRUID 2011 and the various INSNA Sunbelt conferences that I attended over the years, are much appreciated. Furthermore I would like to thank Deloitte Consulting and SOM for supporting me in the completion of my doctoral studies over the previous years. And where would I be without my paranymphs Maarten Aalbers and Wilco Kater, who have been excellent moral support from the beginning to the end. Also great thanks to Mirjam and Wilco's Kater-inn for the great hospitality during my period up North.

Hendrik Leendert Aalbers

About the author

Hendrik Leendert (Rick) Aalbers was born in Zwolle, The Netherlands, on November 19, 1980. He was educated at the Erasmus University (The Netherlands) and the University of British Columbia (Canada) in business and economic policy. In 2004 he received a Masters degree in Business Administration from Rotterdam School of Management and obtained a second Masters degree in Business Economics *(cum laude)* that same year from Erasmus University´s School of Economics. Next to his consulting work at Deloitte Consulting, he enrolled as a PhD student at the SOM Graduate School for Economics and Business at the University of Groningen, The Netherlands. During this period he worked on research that resulted in this thesis and in a number of publications accepted for publication in among others *Journal of Product Innovation Management, MIT Sloan Management Review* and *Innovation Management Policy and Practice*. Additionally he contributed to a number of book chapters exploring network analysis and organizational design that appeared with *Routledge* and *Edward Elgar* publishers. His thesis work has been presented at several major international conferences, including the Academy of Management Conference, the Organization Science Winter Conference, DRUID, the UCD Smurfit Innovation Symposium and several INSNA Sunbelt conferences. Moreover, Rick serves as ad hoc reviewer for the ISI-indexed journals 'Review of Social Economy' and 'Human Resource Management'.

Rick currently holds a position as manager at Deloitte Consulting where he concentrates on strategic change in the financial services industry. As researcher he is affiliated with the department of Innovation Management & Strategy at SOM, the research institute of the Faculty of Economics and Business of the University of Groningen, where he focuses his research on inter- and intra-organizational innovation policy, new business development and organizational restructuring.

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“Nothing endures but change.”

Heraclitus (540 BC – 480 BC), from Diogenes Laertius, Lives of Eminent Philosophers